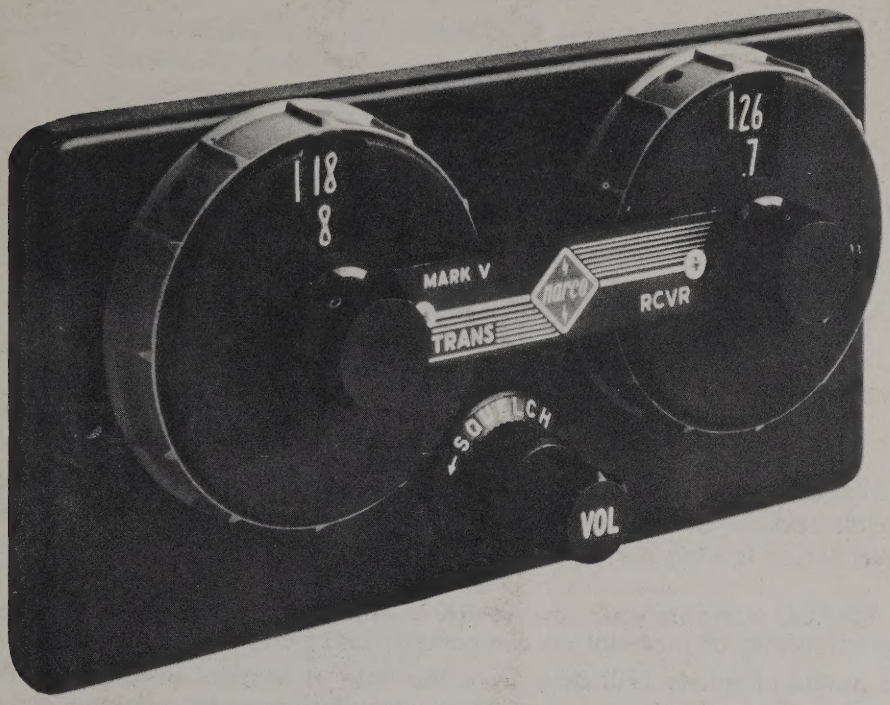

NARCO MARK V

with CN50C, CN50G, CN50K, CN50J

OPERATION · INSTALLATION and SERVICE MANUAL

NARCO AVIONICS
DIVISION OF NARCO SCIENTIFIC INDUSTRIES
FORT WASHINGTON, PENNSYLVANIA, 19034 U.S.A.

Warranty

We have designed and constructed this equipment using the finest materials and components available. It has been thoroughly tested and inspected before leaving our factory.

NARCO warrants your new MARK V and T( )MP-7 against all defects in workmanship or material on components and parts manufactured by us for a period of ninety (90) days from the date of original installation. We will replace any part of our manufacture which proves to be defective within this time under normal installation and operating conditions (except fuses and receiving-type tubes), provided the defective part is returned, transportation charges prepaid, either to the factory or to a NARCO Authorized Warranty Service Center.

To place your warranty in effect you must complete the enclosed Warranty Application Card and mail it to us within ten (10) days after your new installation is completed. By return mail you will receive your NARCO Warranty Certificate, recognized by any NARCO Authorized Service Agency.

NARCO AVIONICS
DIVISION OF NARCO SCIENTIFIC INDUSTRIES
Fort Washington • Pennsylvania

Perfection in Electronics

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SECTION I

INTRODUCTION AND OPERATION

A. GENERAL DESCRIPTION

The NARCO MARK V is a crystal-controlled VHF receiver and transmitter designed to provide two-way voice communications between aircraft and ground stations, or between aircraft in flight, and to provide VOR/LOC navigation reception with the addition of a suitable navigation converter, such as the NARCO VOA-3A. Ninety crystal-controlled transmitter channels provide coverage every 100 Kc. from 118.0 to 126.9 Mc. One hundred and ninety crystal-controlled receiver channels, from 108.0 to 126.9 Mc., provide reception of the communication and navigation range.

A separate unit, the NARCO T(-)MP-7 Transistor Modulator-Power Unit provides audio amplification and modulation, and supplies all power required by the MARK V.

B. SPECIFICATIONS

1. RECEIVER

a. Frequency Coverage—190 channels, 108.0 to 126.9 Mc., 100 Kc. steps.

b. Sensitivity—1.5 microvolts, modulated 30% at 1000 cps. for 1 watt output, 6 db signal plus noise to noise ratio.

c. Bandwidth—42 Kc., 6 db down; 160 Kc., 60 db down.

d. Image Rejection — 80 db minimum; double conversion superheterodyne.

e. AVC—Within 3 db, 10-10,000 microvolts. Time constant automatically changed to suit navigation signals on channels below 118.0 Mc.

f. Audio Response—Within 3 db from 350 to 2500 cps.

g. Noise Limiter—Series—shunt type.

h. Squelch—Audio adjustable; front panel control concentric with volume control.

i. Audio Output—Up to 5 watts; 3 ohm speaker and dual 600 ohm headsets.

2. TRANSMITTER

a. Frequency Coverage—90 channels, 118.0 to 126.9 Mc., 100 Kc. steps.

b. Frequency Stability—Within 0.01%, crystal-controlled.

c. RF Power Output—5 watts, nominal.

d. Modulation—100%, with 8-10 db speech compression.

e. Sidetone—Up to 100 milliwatts.

f. Microphone—Standard carbon or noise- cancelling.

3. TRANSISTOR MODULATOR POWER UNIT—T(-)MP-7

a. Type—Transistorized, with toroid power transformer; provides power for transmitter, receiver, and accessory units (VOA-3A Omni Converter and LFR-3 Receiver).

b. Control—Transmit-Receive relay, operated by microphone switch.

c. Filtering—LC filter networks insure clean, hum-free operation.

d. Fuses—10 Ampere, slow-blow (13.75v.), 6.25 Ampere, slow-blow (27.5v.).

e. Modulation — Three transistors provide audio for 100% modulation to transmitter. Screwdriver-adjusted control compensates for different microphones.

4. GENERAL INFORMATION

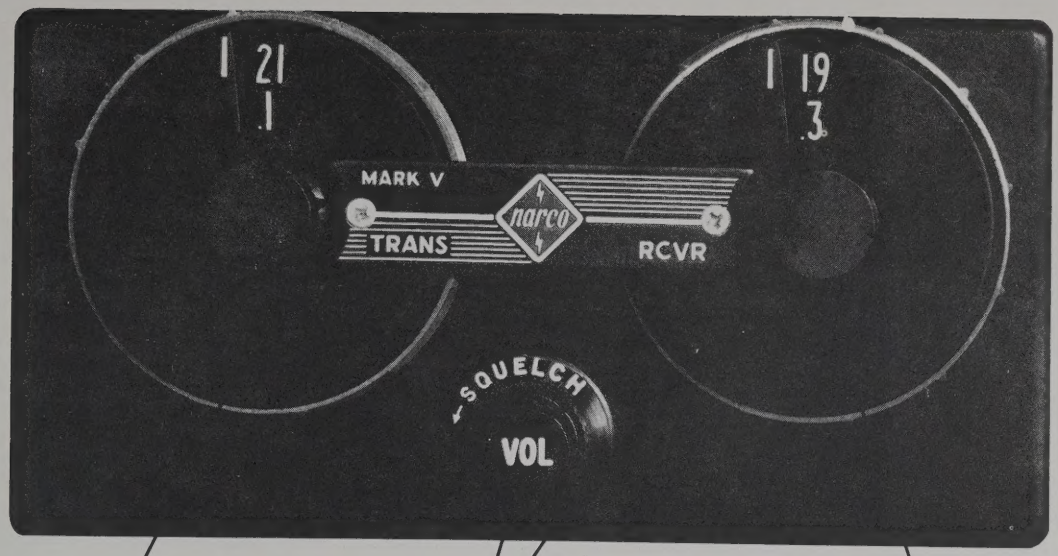
a. Weight — Transmitter and Receiver Unit — 6 lbs. Power Supply T(-)MP-7 — 3.5 lbs.

b. Size—Transmitter and Receiver Unit—3" H. x 6-9/32" W. x 12" L. Power Supply T(-)MP-7—6-3/8" x 3-5/8" x 4-1/2".

c. Power Drain—13.75 Volts: 6.5 Amp., Receive; 8.5 Amp., Transmit. 27.5 Volts: 3.3 Amp., Receive; 4.3 Amp., Transmit.

d. Voltage Changeover—Panel units interchangeable for 13.75/27.5 Volts.

e. Accessories—Provision for powering VOA-3A Omni Converter and LFR-3 Low Frequency Receiver.



TRANSMITTER CHANNEL SELECTOR SHOWN SET AT 121.1 MC.

SQUELCH CONTROL CONCENTRIC WITH ON/OFF-VOLUME CONTROL

RECEIVER CHANNEL SELECTOR SHOWN SET AT 119.3 MC.

Figure 1.

C. OPERATION

1. ON/OFF—VOLUME CONTROL

The small outer knob marked "VOL" controls the receiver audio level and also serves as the power on-off switch. Rotating this knob clockwise from the OFF position applies primary power to the set; by further advancing the control, the loudness of the received signals is increased. The volume setting does not affect navigation signals.

2. SQUELCH

The inner knob marked ' 'SQUELCH" controls the squelch circuit, used to eliminate receiver background noise when no signal is being received, or eliminate undesirable weak signals while receiving. This knob should be turned counterclockwise to the point where any objectionable RF noise interference or weak signals just disappears; a signal that is stronger than the noise will "break" the squelch and be heard at the receiver output. This setting will vary with the different levels of interference encountered. Too high a setting (counter-clockwise) in a low noise area, can result in missing a weak signal that otherwise might be heard. Squelch can be used for navigation reception, but care should be taken to insure that weak omni audio indentification signals are not missed by to high a setting. Receiver operation may be checked at any time by "opening" the squelch so that the background noise and hiss can be heard.

3. RECEIVER CHANNEL SELECTION

Select the desired receiving channel by turning the large inner knob of the right hand channel selector until the correct megacycle channel appears in the window, then turning the small outer knob until the correct tenth-megacycle channel appears just below. In this manner, any one of 190 crystal-controlled channels may be selected.

4. TRANSMITTER CHANNEL SELECTION

Selection of the desired transmitting channel may be accomplished by using the left-hand (transmitter) channel selector knobs in the same manner as for receiver channel selection. Any one of 90 crystal-controlled channels may be selected.

Either simplex or cross channel operation is possible, by selecting the same or different transmitting and receiving channels. The transmitter is placed in operation by pressing the push-to-talk switch on the microphone; relays in the power-modulator unit and the panel unit are controlled by this switch. Allow a sufficient filment warm-up period, when the set is turned on, before keying the transmitter.

D. LICENSE NOTICE

The Federal Communications Commission requires that the operator of this transmitter hold a Restricted Radio-Telephone Operator Permit, or higher class license. This permit may be obtained by any U. S. citizen from the nearest field office of the F.C.C.; no examination is required.

The transmitter itself, as installed in the aircraft, requires a Private Aircraft Radio Station License. This license is obtained by filling F.C.C. Form 404. Technical data is on file with the F.C.C. under the heading, NARCO MARK V.

SECTION II

INSTALLATION

A. EQUIPMENT INITIALLY SUPPLIED BY NARCO

1. MARK V VHF communications equipment, in case and with mounting brackets.
2. Transistor-Modulator-Power Unit T(-)MP-7, with mounting plate.
3. Connectors:
   a. Receiver antenna plug, Narco Part No. 41237-1 & 2.
   b. Transmitter antenna BNC connector, Narco Part No. 41152-1.
   c. Cable connector, (AN-3016A-20-29S), Narco Part No. 41233 3.
   d. Cable clamp, Narco Part No. 41228-6.
   e. Cable connector assembly, Narco Part No. 41240-101.
4. Tools:
   a. Hex wrench for front panel knobs, Narco Part No. 84045-3.
   b. Hex wrench for internal gears, Narco Part No. 84045-2.

B. EQUIPMENT AVAILABLE FROM NARCO

1. Power cable—Narco Part No. 90550. Eight foot length with accessory connections.
2. Antennas:

   Communications—

   a. VSAC-1, Sapphire Communications Antenna, Narco Part No. 71144-103.
   b. VTP-17, Communications Antenna, Narco Part No. 71111.

   Navigation—

   a. VRP-15A, Mast-type VOR receiving antenna, Narco Part No. 71151.
   b. VRP-37, fin-mounting VOR receiving antenna, Narco Part No. 71126.
3. Accessories—

   Narco Model VOA-3A Omni Converter.
   Narco Model LFR-3 or 3L Low Frequency Receiver.

C. EQUIPMENT REQUIRED, BUT NOT SUPPLIED BY NARCO

1. Headphones—low impedance type, 300 to 1000 ohms.
2. Loudspeaker—4 to 15 ohms nominal voice coil impedance.
3. Low impedance carbon microphone, noise-cancelling type is recommended, such as Electro Voice Model L205KK or Telephonics RS38D2, with push-to-talk switch.
4. Headphone and microphone jacks.

D. INSTALLATION INSTRUCTIONS

1. TRANSMITTER-RECEIVER UNIT (MARK V)

a. A rectangular opening, 6-1/8" wide by 3" high, should be provided in the instrument panel. Refer to the installation diagram (fig. 2).

b. With the set removed from the case, install the case in this opening using the mounting flanges provided, and machine screws and stop-nuts. The front of the case should extend in front of the panel about 5/16".

c. Install a rear support from the stud on the rear of the case to some nearby structural member. Allow sufficient space behind the case for cables, and for access to the air-lock fastener.

d. Slide the set into the case, feeding the pigtail cable through the cutout, and secure with a quarter turn of the air-lock fastener on the rear of the case.

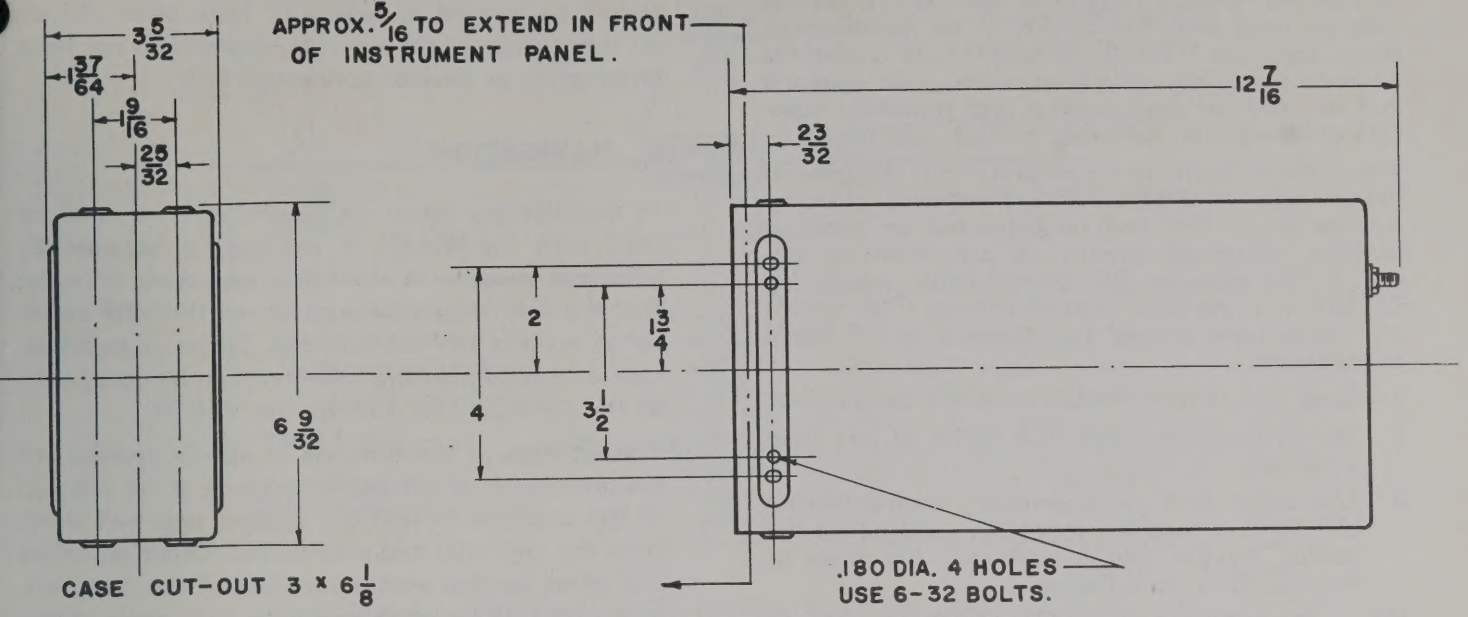
2. TRANSISTOR MODULATOR-POWER UNIT (T(-)MP-7). (Figure 2).

a. Fasten the power unit mounting plate to either a vertical or a horizontal surface using four #10 machine screws and stop-nuts.

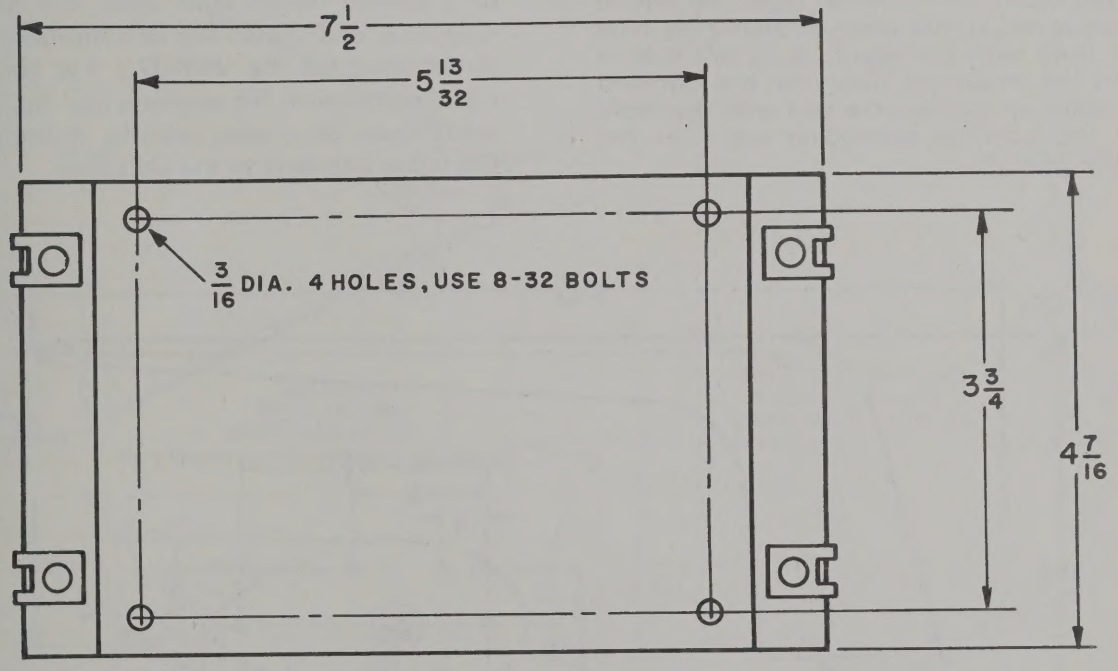
b. Attach the two power unit mounting brackets to the power supply.

c. Start the four power unit mounting screws into the mounting plate, leaving approximately 1/8" between their heads and the "U" nuts on the plate.

d. Slide the power unit into place, and move it to the proper side to engage the mounting screws in the slots provided for them; tighten the mounting screws.



TRANSMITTER-RECEIVER UNIT—MOUNTING DIMENSIONS



ALLOW SPACE FOR CONNECTORS AND CABLES

T( ) MP-7 MODULATOR-POWER UNIT MOUNTING DIMENSIONS

Figure 2.

E. ANTENNAS

1. COMMUNICATION

Any of the NARCO vertical or bent whip antennas may be used with the MARK V for communications: Sapphire VSAC-1, or VTP-17. If a suitable antenna switching relay is provided, one antenna can be used for both receive and transmit; separate antennas may be used for each function.

The VSAC-1 Sapphire Communications Antenna is designed for installation on the external airframe surface in as flat and unobstructed an area as possible. Mounting dimensions are shown in figure 3. The antenna RF coaxial cable should be RG-58A/U using BNC coaxial fittings. The following precautions should be observed in RF cable installations.

1. Keep the antenna cable as short as possible.
2. Do not bend the cable in a radius of less than 2 inches.
3. Use extra care in assembling and soldering UG-88/U connectors, especially noting that the center "needle" pin is flush with the plane of the UG-88/U shell flange.

When the transmitting and/or receiving antenna to be used is a VTP-17, it should be mounted on a metal plate measuring at least 18" square; such a mounting plate is often found directly in front of the windshield in fabric-covered ships, and at the center of the cabin roof in metal ships. Where no such surface exists, a thin piece of aluminum may be affixed flush with the fabric. A 7/16" hole is required in the mounting plate for the antenna insulator, which should be arranged with the male portion of the insulator protruding out from the inside of the aircraft.

Do not lengthen or shorten the antenna, as it has been cut to the proper length for most efficient radiation at the frequencies used. The antenna(s) should be located at least 12" from other objects on the surface of the aircraft, and should not have other wires or devices connected to it.

2. NAVIGATION

In installations where an omni converter is to be used with the MARK V receiver, **a horizontally polarized antenna is absolutely necessary,** in order that the full range and accuracy of the VHF omnirange system can be realized. Either a pedestal-type or a tail-mounting antenna may be used, such as the NARCO VRP-15A or the VRP-37.

The location of the antenna is also of paramount importance. It is advisable to place it on the top of the airplane behind the cockpit and well away from the engine(s) and propellor(s). Other antennas and wires located within two feet of the omni antenna may cause weak reception from some directions, and should be avoided. The rods should be horizontal in level flight attitude.

The VRP-15A antenna has a built-in balun, made of a special transmission cable cut to critical dimensions, and should not be disturbed. If the mast is not used (as the VRP-37), this balun must be installed between the antenna and the cable to the set. Ground all coaxial sheaths at the point where the balun connects to the set cable.

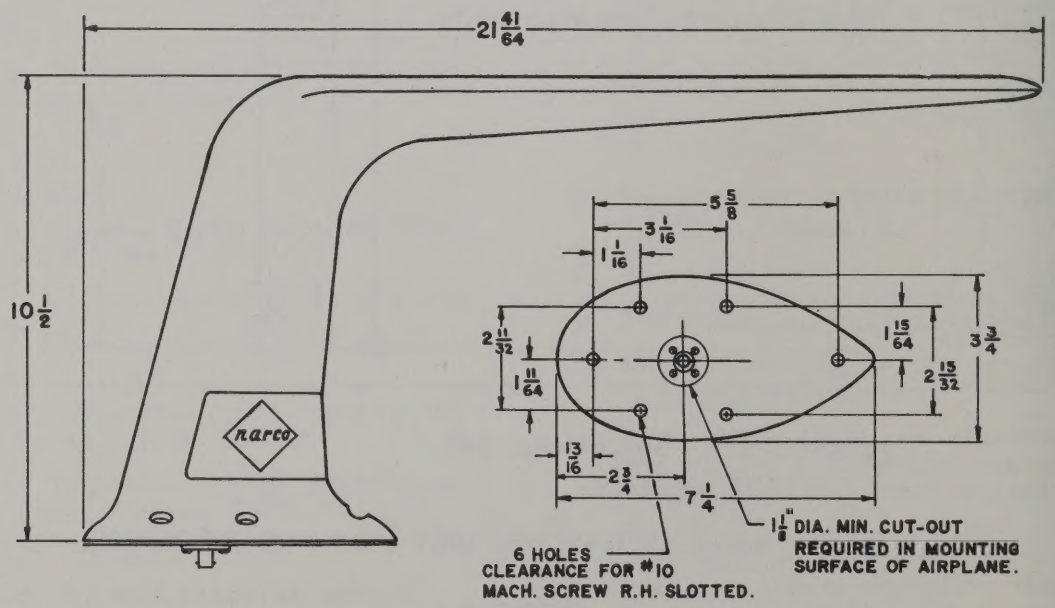


Figure 3. VSAC-1 ANTENNA — MOUNTING DIMENSIONS

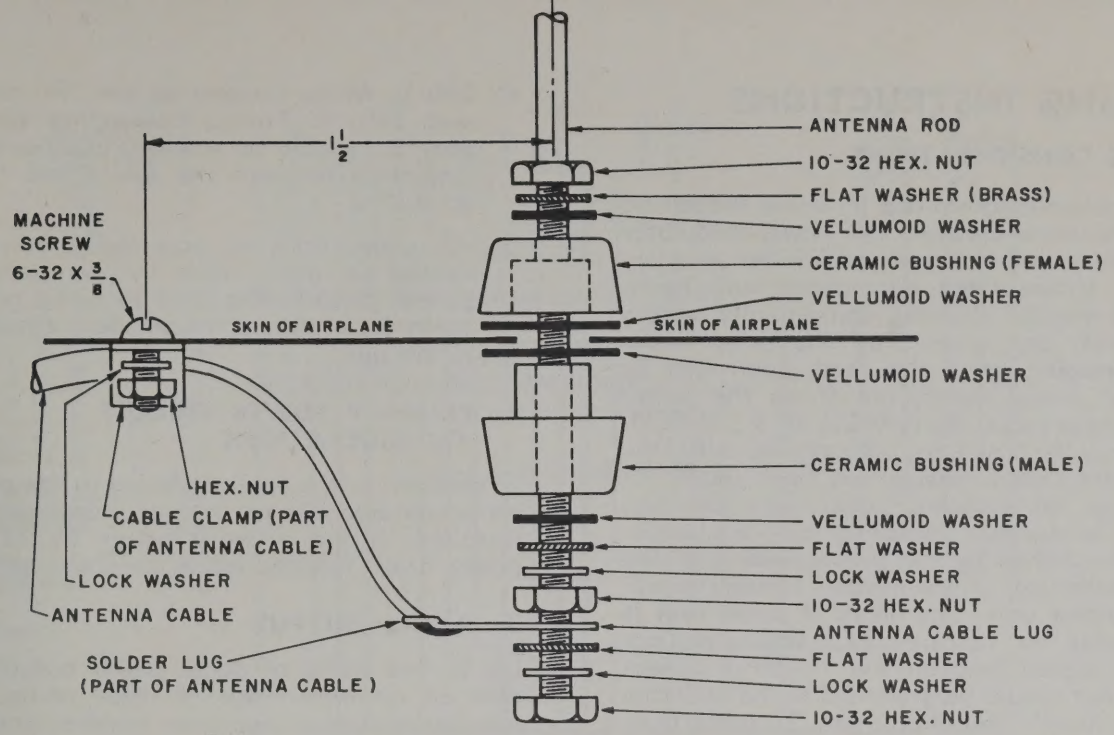


Figure 4. TRANSMITTING ANTENNA — MOUNTING DIAGRAM

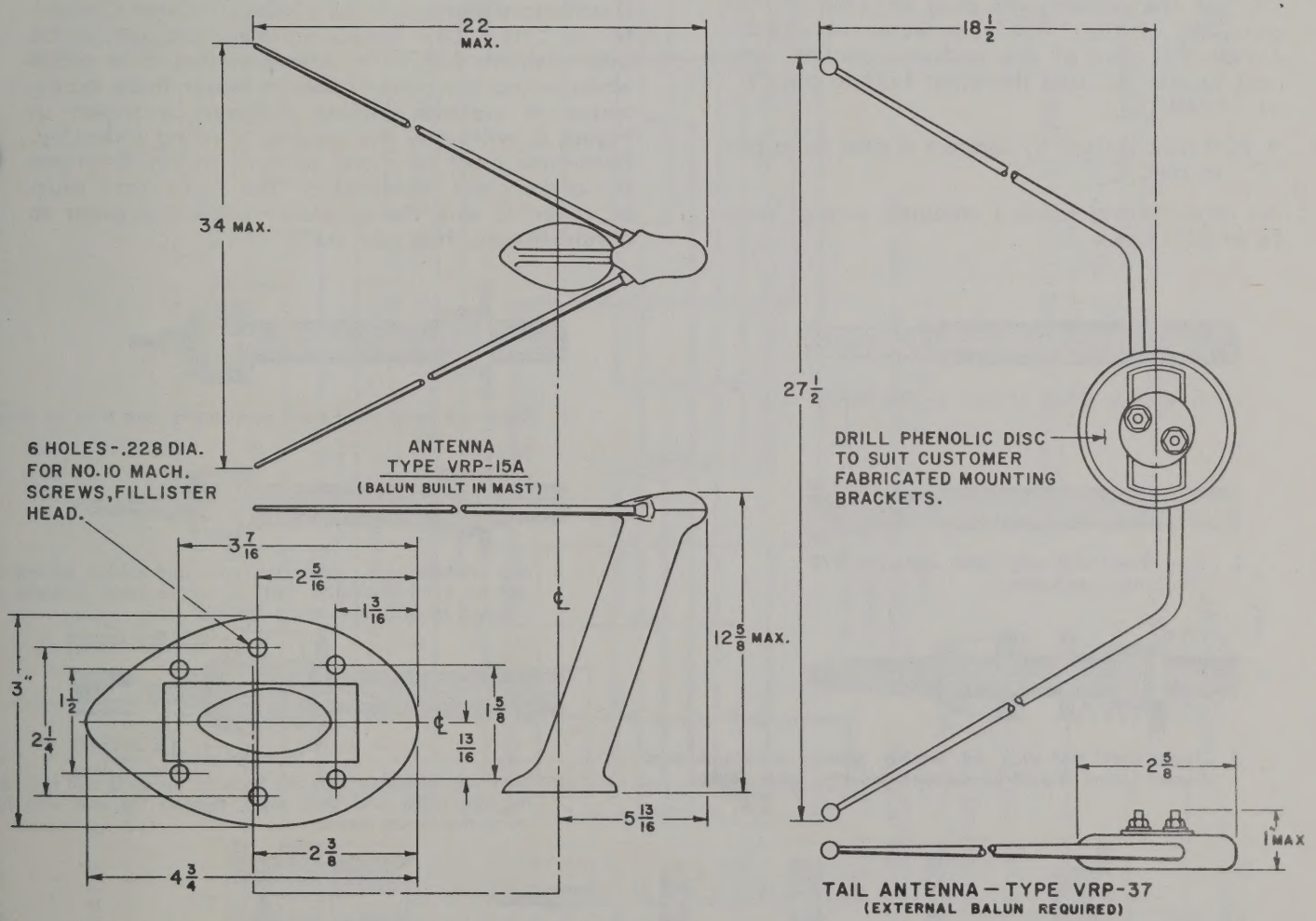


Figure 5. RECEIVING ANTENNA — MOUNTING DIAGRAM

F. CABLING INSTRUCTIONS

1. WIRING CONSIDERATIONS

The basic cabling diagram (fig. 7) shows the wiring of the connections between the power-modulator unit and the panel-mounted transmitter and receiver unit. Un-insulated microphone and headphone jacks may be mounted conveniently on the aircraft panel, and wired into the power-audio cable. By bringing an A-plus lead, controlled by the Mark V power switch, out (from the power cable) with these jacks, the NARCO VP-9 SWITCH-MASTER may be used in conjunction with the Mark V. Note that provision has been made for the wiring of an external panel light dimmer, should such be desired. Operating voltage change-over is accomplished by the proper wiring of the **cable** and selection of the proper voltage power supply-modulator unit. The Mark V panel unit is interchangeable for 13.75 or 27.5 volt operation. The 6 inch pigtail lead on the T(-)MP-7 Power-Modulator Unit should be grounded to the airframe at the power supply mounting plate. To avoid trouble in fabricating the cable, the following details and precautions should be observed.

1. A #16 wire is used to connect pin "E" and pin "K" of the rectangular plug (41240-101) to pin "H" of the "AN" connector (41233-3). Divide this wire at one end and connect one half to pin "K" and the other half to pin "E" of 41240-101.
2. A #20 wire is used to connect A-plus from pin "C" to pin "C."
3. All other wiring (except shielded wiring) may be of #22 size.
4. 280 V. Mod., connecting pin "F" to pin "T", and 290 V. Trans., connecting pin "L" to pin "S", should be shielded and have 600 volt insulation between the shield and the center conductor.
5. All connections of accessories and junctions should be made inside the connectors to the proper pins, taking care to make good solder joints that will not cause short circuits to adjacent pins.

2. PRIMARY POWER CIRCUIT CONSIDERATIONS

In addition to the fuses installed in the power unit, an acceptable aircraft circuit protector should be installed in the primary power source. Primary power drain information is provided in Section I.

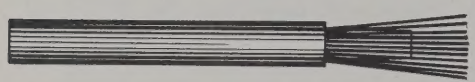
3. AUDIO OUTPUT

Up to five watts of audio power output is available at an impedance of three ohms for loudspeaker operation, and three hundred ohms for two sets of six hundred ohm headphones.

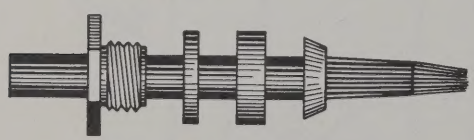
4. ACCESSORY UNITS

If accessory items, such as a VOA-3A Omni-Converter or LFR-3 Low Frequency Receiver, are to be used with the MARK V, provision should be made when wiring the power cable to power these accessories. A systems cabling diagram is shown in Figure 8, with only the accessory wiring indicated. Reference must be made to both wiring diagrams for a complete installation. The same care must be taken to wire the accessory cables, in order to obtain trouble free operation.

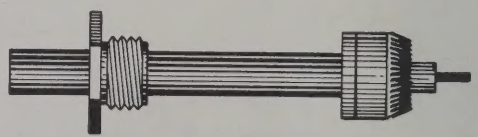
1. Trim cable jacket 19/64" for RG-58A/U.



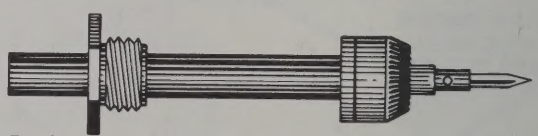
2. Fray shield and strip inner dielectric 1/8". Tin center conductor.



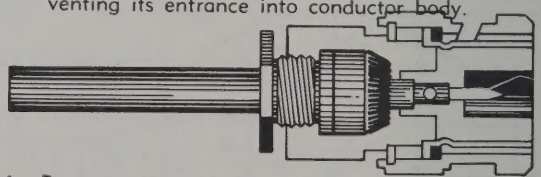
3. Taper braid and slide nut, washer, gasket and clamp over braid. Clamp should be squarely against cable jacket.



4. Comb out braid, fold back over clamp and trim as shown.



5. Slip contact onto center conductor and solder, taking care not to swell dielectric with excessive heat, thereby preventing its entrance into conductor body.



6. Push this assembly into the body as far as it will go. Holding the cable and shell rigid, tighten the nut into body using the proper wrench.

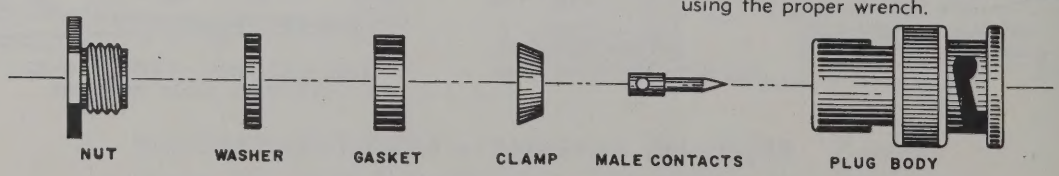


Figure 6. BNC CONNECTOR ASSEMBLY

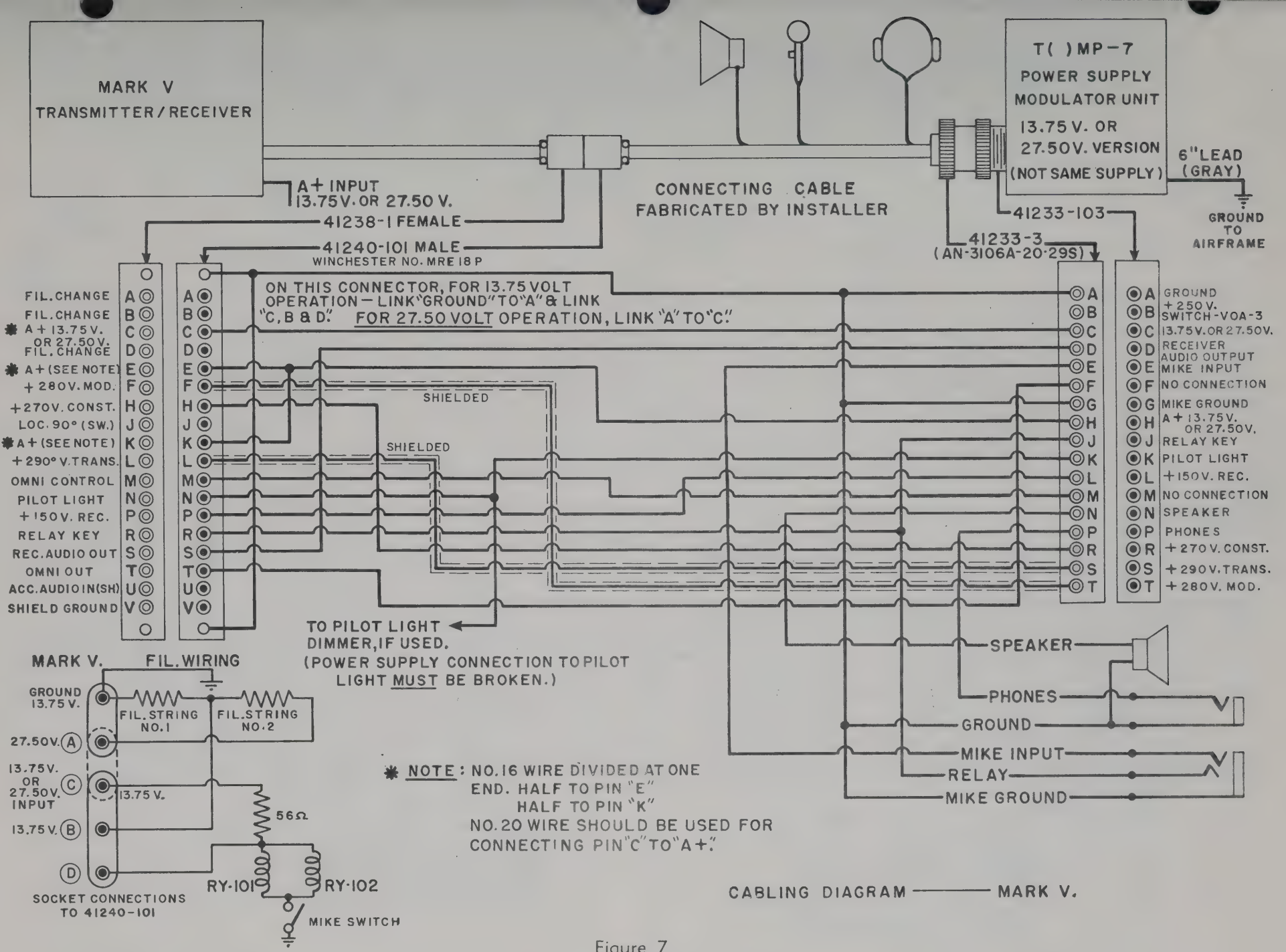

MARK V
TRANSMITTER/RECEIVER
T( )MP-7
POWER SUPPLY
MODULATOR UNIT
13.75 V. OR
27.50V. VERSION
(NOT SAME SUPPLY)
6" LEAD
(GRAY)
GROUND
TO
AIRFRAME
A+ INPUT
13.75V. OR 27.50 V.
41238-1 FEMALE
41240-101 MALE
WINCHESTER NO. MRE 18 P
CONNECTING CABLE
FABRICATED BY INSTALLER
41233-103
41233-3
(AN-3106A-20-29S)
ON THIS CONNECTOR, FOR 13.75 VOLT
OPERATION – LINK "GROUND" TO "A" & LINK
"C, B & D." FOR 27.50 VOLT OPERATION, LINK "A" TO "C."
FIL. CHANGE A
FIL. CHANGE B
* A+ 13.75V. OR 27.50V. C
FIL. CHANGE D
* A+ (SEE NOTE) E
+ 28 0V. MOD. F
+ 270V. CONST. H
LOC. 90° (SW.) J
* A+ (SEE NOTE) K
+ 290° V. TRANS. L
OMNI CONTROL M
PILOT LIGHT N
+ 150V. REC. P
RELAY KEY R
REC. AUDIO OUT S
OMNI OUT T
ACC. AUDIO IN(SH) U
SHIELD GROUND V
SHIELDED
SHIELDED
A GROUND
B + 250 V. SWITCH-VOA-3
C 13.75V. OR 27.50V.
D RECEIVER AUDIO OUTPUT
E MIKE INPUT
F NO CONNECTION
G MIKE GROUND
H A+ 13.75V. OR 27.50V.
J RELAY KEY
K PILOT LIGHT
L + 150V. REC.
M NO CONNECTION
N SPEAKER
P PHONES
R + 270 V. CONST.
S + 290 V. TRANS.
T + 280 V. MOD.
TO PILOT LIGHT
DIMMER, IF USED.
(POWER SUPPLY CONNECTION TO PILOT
LIGHT MUST BE BROKEN.)
SPEAKER
PHONES
GROUND
MIKE INPUT
RELAY
MIKE GROUND
MARK V. FIL. WIRING
GROUND 13.75 V.
FIL. STRING NO. 1
FIL. STRING NO. 2
27.50V. A
13.75V. OR 27.50V. INPUT C
13.75 V.
13.75 V. B
D
56Ω
RY-101
RY-102
MIKE SWITCH
SOCKET CONNECTIONS
TO 41240-101
* NOTE: NO. 16 WIRE DIVIDED AT ONE
END. HALF TO PIN "E"
HALF TO PIN "K"
NO. 20 WIRE SHOULD BE USED FOR
CONNECTING PIN "C" TO "A+."
CABLING DIAGRAM ——— MARK V.

Figure 7.

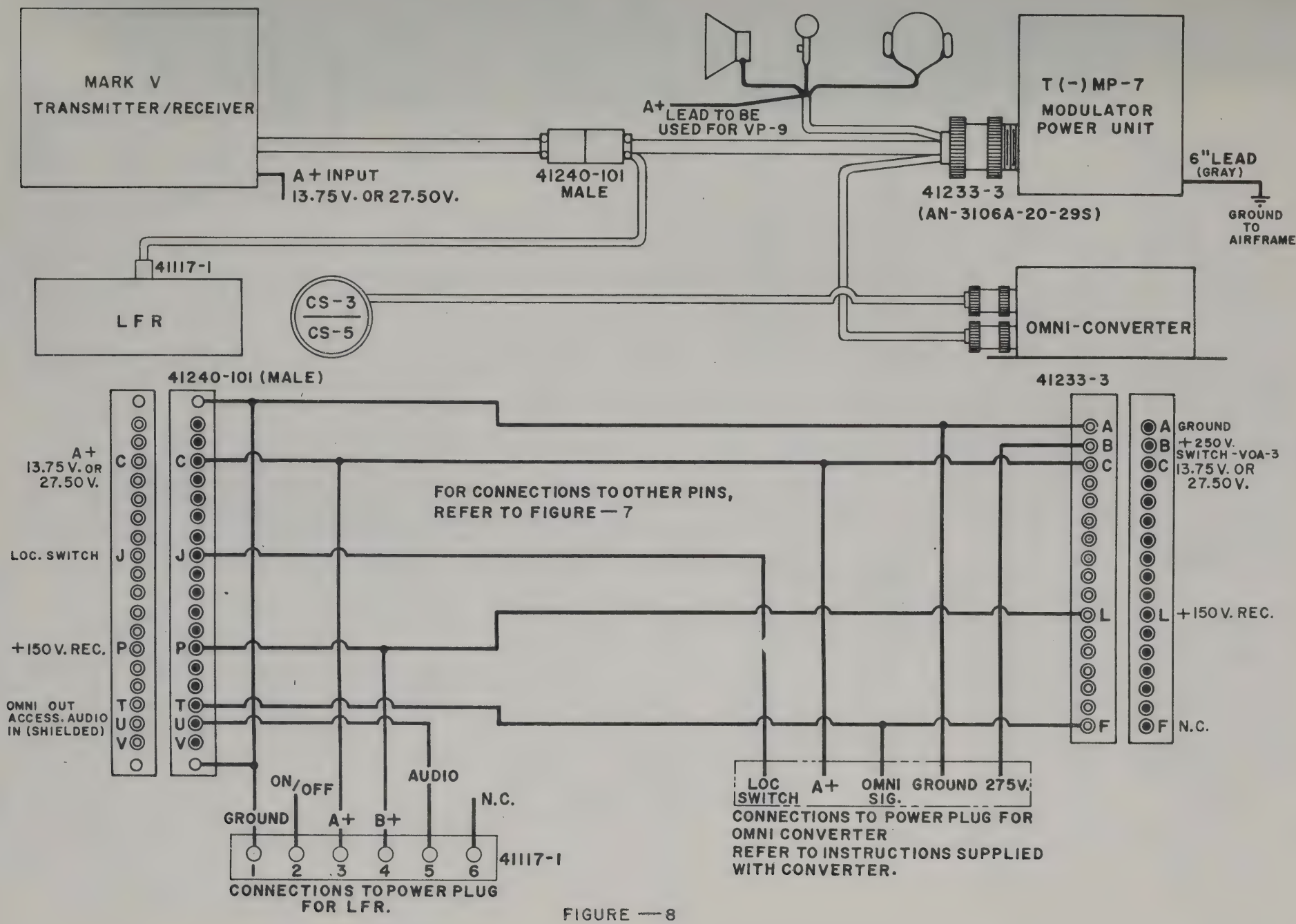

MARK V
TRANSMITTER/RECEIVER
A+ INPUT
13.75 V. OR 27.50 V.
41240-101
MALE
A+ LEAD TO BE
USED FOR VP-9
T(-)MP-7
MODULATOR
POWER UNIT
41233-3
(AN-3106A-20-29S)
6" LEAD
(GRAY)
GROUND
TO
AIRFRAME
41117-1
LFR
CS-3
CS-5
OMNI-CONVERTER
41240-101 (MALE)
41233-3
A+
13.75 V. OR
27.50 V.
LOC. SWITCH
+150 V. REC.
OMNI OUT
ACCESS. AUDIO
IN (SHIELDED)
FOR CONNECTIONS TO OTHER PINS,
REFER TO FIGURE — 7
GROUND
+250 V.
SWITCH - VOA-3
13.75 V. OR
27.50 V.
+150 V. REC.
N.C.
GROUND
ON/OFF
A+
B+
AUDIO
N.C.
1 2 3 4 5 6
41117-1
CONNECTIONS TO POWER PLUG
FOR LFR.
LOC SWITCH
A+
OMNI SIG.
GROUND
275V.
CONNECTIONS TO POWER PLUG FOR
OMNI CONVERTER
REFER TO INSTRUCTIONS SUPPLIED
WITH CONVERTER.

FIGURE — 8

SECTION III

THEORY OF OPERATION

A. RECEIVER

A crystal-controlled, double-conversion superheterodyne circuit is employed in the receiver section of the Mark V. The desired RF signal enters the receiver at the antenna connection and is separated from other signals by the first of three RF tuned circuits. These circuits are tuned in steps of one megacycle with the use of gang-switched, printed-circuit inductance wafers. A high gain 6DK6 pentode is used to amplify this RF signal, which then passes through a capacitively-coupled, double-tuned resonant network to the grid of the first mixer, V-102.

A high frequency IF of 25.9 mc is produced by selecting the difference frequency between the incoming signal and the injected voltage from the HF oscillator, V-103. The injection voltage is the fundamental frequency of this crystal-controlled, grounded-grid oscillator. Fifth overtone crystals are used, covering a frequency range of 82.55 to 100.55 mc., in one megacycle steps. The IF signal passes through a stage of HF IF amplification, with a fixed-tuned band-pass of one megacycle, 25.40 to 26.40 mc. From V-104, the signal goes to V-105, the second converter, where the cathode injected signal from the LF oscillator mixes with the HF IF signal to produce a low frequency IF of 7.0 mc. A triode oscillator, V-106, operating on the fundamental frequency and using third overtone crystals, 32.45 to 33.35 mc., is used for low frequency injection, to select the tenth megacycle steps in any given mc. The output of the second mixer is then passed through three stages of LF IF amplification, involving V-107, V-108, V-109, and eight resonant circuits.

One section of V-110 is used as a high-level diode detector; omni output is taken directly from the diode load. The compound peak noise limiter and the audio volume control are located between the detector and the audio output. The noise limiter comprises two diodes arranged to utilize both series and shunt-type peak limiting in a circuit in which the clipping levels compensate for variations in carrier strengths.

A delayed AVC is developed by a second diode section in V-110, and applied to the RF and IF stages, with the exception of the second converter and the last IF stage. The time constant of this AVC is controlled by the channel selector; for its accurate omni-range bearings, VOR channels require an AVC with a longer time constant than is wanted for communication. A DC amplifier stage in V-110, controlled by AVC action, actuates the squelch audio section of V-112. This squelch section is biased to cut off audio signals, until the signal level rises higher than the noise level setting of the squelch control. A cathode follower audio output, V112B, is used to transform the high-impedance signals to the low-impedance required by the transistorized audio amplifier.

B. TRANSMITTER

Ninety crystal-controlled transmitter channels are provided by the Mark V, using the sum frequency of the two common oscillators for the output.

V-103, a 12AT7, is used as a crystal-controlled, grounded-grid HF oscillator. Employing fifth overtone crystals and operating on the fundamental oscillator frequencies, 85.55 to 93.55 mc., steps of one megacycle, switched by S-206 and 207, provide the basic frequencies, 118 to 126 mc. Similarly, the low frequency oscillator, V-106, is a crystal-controlled triode, using third overtone crystals and operating on the fundamental oscillator frequencies, 32.45 to 33.35 mc. The tenth megacycle steps are provided by this oscillator, controlled by S-208.

The injection voltages from these two oscillators are fed to V-201, the 6CB6 mixer, using screen grid injection of the HFO signal, and control grid injection of the LFO signal. Selected by the plate output tank circuit, the sum frequency of the two signals is coupled to the first buffer-amplifier stage, V-202. The amplified signal is applied to the grid of the second buffer, V-203, where it is further amplified and used to drive the final stage.

A 5686 beam power pentode is used as a final amplifier, delivering approximately five watts of RF carrier output through a band-pass filter to the antenna.

High-level plate modulation is applied to the final amplifier by the T(-)MP-7 Transistorized Modulator-Power Unit.

C. TRANSISTOR MODULATOR-POWER SUPPLY

The T(-)MP-7 power supply utilizes one of the most recent designs in power converters. The conventional vibrator or dynamotor has been replaced with power transistors. With no moving elements to be damaged by vibration and mechanical shock, the transistor has tremendous advantage over the conventional supply. Efficiency has also increased; the transistorized supply is from 20 to 40% more efficient than the vibrator or dynamotor.

The power supply section of the T(-)MP-7 uses two power transistors, Q-401 and 402, and a toroid power transformer, T-401, in a circuit whose simplified operation is as follows: The instant A-plus is applied, because of the inevitable dissimilarity of the two transistors, more current will begin to flow through one than the other. This greater flow of current through one half of the primary winding will induce a current in the bias winding so polarized as to bias the conducting unit into greater conduction and hold the non-conducting unit at cut-off. Almost instantly, the transformer core reaches saturation, i.e., the transformer can pass

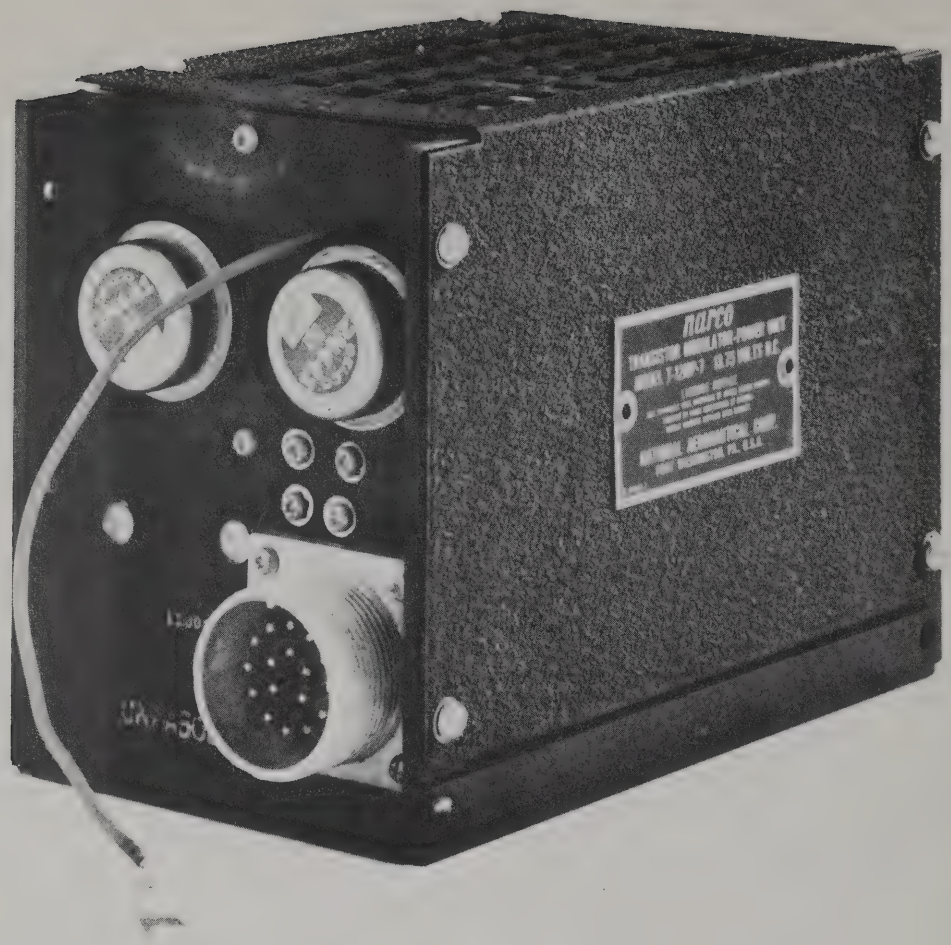


Figure 9.

no greater amount of current, and reaches maximum flux density. Since there are no longer any moving lines of force, no voltage is induced in the bias winding, and the current through the conducting transistor starts to decrease. As the current in one half of the primary winding decreases, the induced voltage in the bias winding reverses polarity, causing the second transistor to conduct. Capacitors C-403 and C-404 in the base voltage divider network store energy, which, at the conclusion of each half cycle is used to switch the oscillator, since the high-nickel core materials used in the transformer do not provide the necessary inductive "kick" needed to switch from one half cycle to the next. This switching action repeats at a very high speed, and the output of T-401 is essentially a clean square wave with a repitition rate of approximately 1500 cycles. Rectification is accomplished with the use of four silicon diodes, CR-401, 402, 403, and 404. LC filtering is performed easily and efficiently, due to the high cyclic rate of the oscillatory output of the supply; clean hum-free DC output, without the spikes that produce RF interference, is provided for the operation of the transmitter and receiver. The audio section of the T(-)MP-7, including transistors Q-301, 302, 303, and associated components, provides amplification for either the receiver output or the microphone. The transmit-receive relay, K-401, connects the base of the input transistor, Q-301, to either the receiver or the microphone output. Q-301 is a Class A current amplifier, which functions as a driver for the Class B output amplifier stage. The audio output transformer, T-302, is equipped with two secondary windings, one tapped winding to operate the speaker or headsets, and the other for modulating the transmitter.

The audio section includes the "mike gain" control, R-301, located on the lower corner of the audio transistor mounting plate, and the "mod. adj." slider resistor, R-308, located under the chassis. R-301 is used to compensate for differences in aircraft cabin noise and modulation characteristics of microphones. R-308, the "mod adj" resistor, limits the maximum power output of the Class B stage to approximately 7.5 watts, to prevent overmodulation of the transmitter output. From 6 to 14 db of speech clipping is provided by the system, depending upon the type of microphone used and the setting of R-301. Using a T-17 microphone and with R-301 set fully on, six db of speech clipping is provided, while a microphone with a higher output, such as an Electro-Voice, Model 205, used in a quiet airplane, can give up to 14 db of clipping. This degree of speech clipping, which raises the level of the consonant sounds in the speech, increases the "voice power" of the transmitted signal four or five times.

SECTION IV

MAINTENANCE

A. MAINTENANCE PROCEDURES (Mechanical)

1. Access to shielded sections of the front end is accomplished by removing the two shields on top and one on the bottom of the set. The positions of the components in these shielded sections are critical and should not be altered or disturbed in any way, unless it is absolutely necessary.

2. **Replacement of Defective Crystals.**

   1. Any crystal, 82.55 to 85.55 mc. and 92.55 to 100.55 mc., can be removed by unsoldering the leads and pulling it out of the assembly. Insert the replacement crystal in its proper slot (refer to Figure 10), re-solder, taking care to replace any damaged insulation.
   2. The crystals from 86.55 to 89.55 mc. can be replaced if the adjacent vertical shield (held in by **three** screws) is removed. Replacement is then accomplished as in Step 1.

3. **Shaft Alignment for Channel Selectors. (Figure 10)**

   1. Receiver—

      a. Set receiver detent in any position, and dial at 108.0 mc. Tighten set screws on gear 1, mounted on detent shaft shown in section A-A with setscrews oriented as shown.

      b. Align 1/4" receiver crystal shaft and switch shaft as shown in section B-B, and tighten gear 2. Rotate dial to 126.0 mc. and further adjust gear 2 so that the gears run smoothly and switch rotor tabs make proper contact with the clips at the 126 and 108.0 mc dial positions, i.e., the rotor tab position should be equalized with respect to the centerline of the clips at the extreme dial positions.

      c. Crystal-bank wafers should be adjusted, if necessary, by means of their mounting screws, to provide free running shafts and gears.

      d. Tighten set screws on gear 2 and align receiver switch rotors (section B-B) with dial at 108 mc.; tighten gear 3 with set screws and set receiver shaft 1 and rotor tab positions as shown in section B-B. Tighten gear clamp 1 and rotate dial to 126.0 mc. Adjust gear clamp 1 so that the gears run smoothly. The rotor position should be equalized relative to the centerline of the clips at the extreme positions of the dial (108. and 126. mc).

      e. Gear backlash can be adjusted by shifting receiver switch wafer locations, utilizing attaching screws, 10 and 11.

   2. Transmitter—

      a. Set transmitter mc detent in fully CCW position, and dial at 118. mc. Tighten small gear on detent shaft with set screws as shown in section C-C. Align the 3/8" transmitter crystal shaft so that rotor tab and shaft position correspond to that shown in section D.D. Lightly tighten gear 4 (set screws positioned as in section C-C) and rotate dial to 126 mc. Adjust gear so that rotor tab position relative to the centerline of the clips at the extreme dial positions (118 to 126 mc.) is equalized. Then tighten gear 4 shown in section C-C.

      b. To adjust transmitter shaft, first set the dial at 118 mc. Align transmitter rotors and shaft as shown in Section D-D. Tighten gear 5 to transmitter shaft and lightly tighten gear 6 (section D-D). Rotate dial to 126mc. and adjust switch wafers, using their mounting bolts, so the gears run smoothly and with minimum backlash. Adjust gear 6 to equalize the rotor tab position relative to the centerline of the clips, at the extreme dial positions. Tighten gear 6.

B. TROUBLE-SHOOTING PROCEDURES

The following data is provided as an aid to isolation of trouble, should it develop. Care should be taken to avoid moving or changing lead dress when trouble-shooting.

1. Receiver Trouble-Shooting Chart

NOTE: After isolating the trouble, reference to alignment procedure will provide additional information.

Signal Generator is modulated 30% at 1000 cps.

Volume control and squelch control should be set fully clockwise.

Step	Test	Test Signal	Test Point	Normal Indication	Probable Cause of Abnormal Indication
1	Overall check	VHF Sig. Gen. 1.8 uv., set on receiver channel, input at antenna terminal.	Audio wattmeter at speaker	1.6 watt output; AVC actuates at 6-9 uv.	Proceed to following steps.
2	Pre-detector	Sig. Gen. 6uv., set on rec. channel.	AC VTVM on detector side of R-127	2 volts AC. Proceed to step 8.	Proceed to step 3.
3	Low Freq. I.F.	VHF Signal Generator 200 uv., 7 Mc. Pin 1, V-107	AC VTVM on detector side of R-127	0.12 VAC	Failure of V-105, 107, 108 or 109; defective component in LF IF
4	Low Freq. Osc. & LF Converter Gain	Receiver set .00-.90 Signal Gen. set 200 uv., 27.05-27.95 Mc. Pin 1, V-105	AC VTVM on detector side of R-127	0.2 VAC (2-1 variation from .9 to .0)	Failure of V-106; defective component in Low Freq. Osc. stage
5	High Freq. I.F.	Receiver set .00-.90 Signal Gen. set 5 uv., 27.05-27.95 Mc. Pin 1, V-102	AC VTVM on detector side of R-127	0.5 VAC	Failure of V-102, 104; defective component in HF I.F. stages
6	High Freq. Osc. High Freq. Conversion Gain	Receiver set to 108.5-126.5 Mc. Signal Generator set 20 uv., 108.5 - 126.5 Mc Pin 1, V-102	AC VTVM on detector side of R-127	0.5 VAC	Failure of V-103; defective component in High Freq. Osc.
7	R.F. Amplifier	Receiver set to 108.5 - 126.5 Mc. Signal Generator set 5 uv., 108.5 - 126.5 Mc. Rec. Ant. Conn.	AC VTVM on detector side of R-127	2 VAC	Failure of V-101; defective component in R.F. Amplifier stage
8	Receiver Audio Section	Sig. Gen. on Rec. channel; Volume and squelch open. 2 volts AC at detector (R-127)	AC VTVM on Pin 8 of V-112-B	0.4 VAC	Follow normal audio trouble-shooting procedures

C. ALIGNMENT PROCEDURES

1. EQUIPMENT REQUIRED

Transmitter—

a. RF wattmeter and 50 ohm dummy load (Bird Model 61 or equivalent).

b. VTVM (RCA Voltohmyst or equivalent).

c. Carbon microphone.

Receiver—

a. AC VTVM (Ballantine Model 300 or equivalent).

b. Low frequency signal generator (General Radio Model 1001A or equivalent).

c. High frequency signal generator (Hewlett-Packard Model 608D or equivalent).

d. Sweep generator (Kay Vari-Sweep or equivalent).

e. High input impedance VTVM (RCA Voltohmyst or equivalent).

f. Oscilloscope (Dumont Model 401 or equivalent).

g. High input impedance detector (specially constructed; refer to Figure 12).

i. Audio wattmeter (General Radio Type 583-A or equivalent).

j. Headphones, low impedance (600 ohms).

General—

a. Variable primary power source (Electro Model NF or equivalent).

2. RECEIVER ALIGNMENT

Low Frequency IF Stages

1. Connect the AC VTVM to the detector side of R-127.
2. Connect the vertical input of the oscilloscope to the same point to monitor the output. Set the horizontal sweep to INTERNAL.
3. Disconnect pin 1 of V-105 from T-102, leaving R-111 in the grid circuit.
4. Connect the low frequency signal generator (set to 7 mc) to pin 1 of V-105.
5. Tune the low frequency IF transformers, T-103, 104, 105 and 106 for maximum AC voltage. 10 uv. input should give approximately 0.12 VAC output.

Low Frequency Oscillator

1. Set receiver KC dial to .00 position.
   Set transmitter KC dial to .90 position.
2. Connect VTVM on R-164 and use the negative 15 volt scale.
3. Connect the wattmeter to transmitter output on the rear of the chassis.
4. Key the transmitter and tune L-115 for maximum negative voltage. Voltage indications should range from approximately —5 VDC in .00 position of receiver KC dial to —14 VDC in the .90 position.

Low Frequency IF Conversion Gain

1. Connect the AC VTVM to the detector side of R-127.
2. Connect the high frequency signal generator (set to the 25-27mc. range, 200uv. output) to pin 1 of V-105.
3. Set the receiver KC dial to .90 position.
4. Set signal generator to 26.35 mc. Record indication from AC VTVM; this should be betweeen .5 and .8 VAC.
5. Set the receiver KC dial to the .00 position.
6. Set the signal generator to 25.45 mc. Record indication from AC VTVM; this should be between .2 and .4 VAC.
7. The calculated difference should be 6db or better between the .00 and the .90 indications.

High Frequency IF Stage

1. Disconnect pin 5 of V-105 from T-103, and install the high input impedance detector (refer to Figure 12) as follows:

   Connect 470 ohm resistor from B-plus side of T-103 to pin 5 of V-105.
   Connect 4.7 mmfd capacitor from detector to pin 5 of V-105.
   Connect the output of the detector to "Y" input of the oscilloscope.
   Connect the AC VTVM to the "Y" input of the scope.
   Ground detector to receiver chassis.
   Connect A-plus to pin 5 of V-112.

2. Set scope horizontal sweep to "EXTERNAL."
3. Connect the sweep output of sweep generator (sweep frequency— 25.90 mc.) to the "X" input of the scope.
4. Disconnect L-125 from pin 1 of V-102, leaving R-104 in the circuit.
5. Connect RF output of sweep generator to pin 1 of V-102.
6. Tune the high frequency IF transformers, T-101 and 102, for the response in Figure 13. Loop couple signal from high frequency signal generator to pin 1 of V-102 in order to position the 25.45 and 26.35 mc peaks.
7. A 2:1 ratio (6 db) should exist between the 25.45 and 26.35 mc peaks.

High Frequency Oscillator Tuning

1. Connect a 10K ohm isolation resistor to pin 2 of V-103.

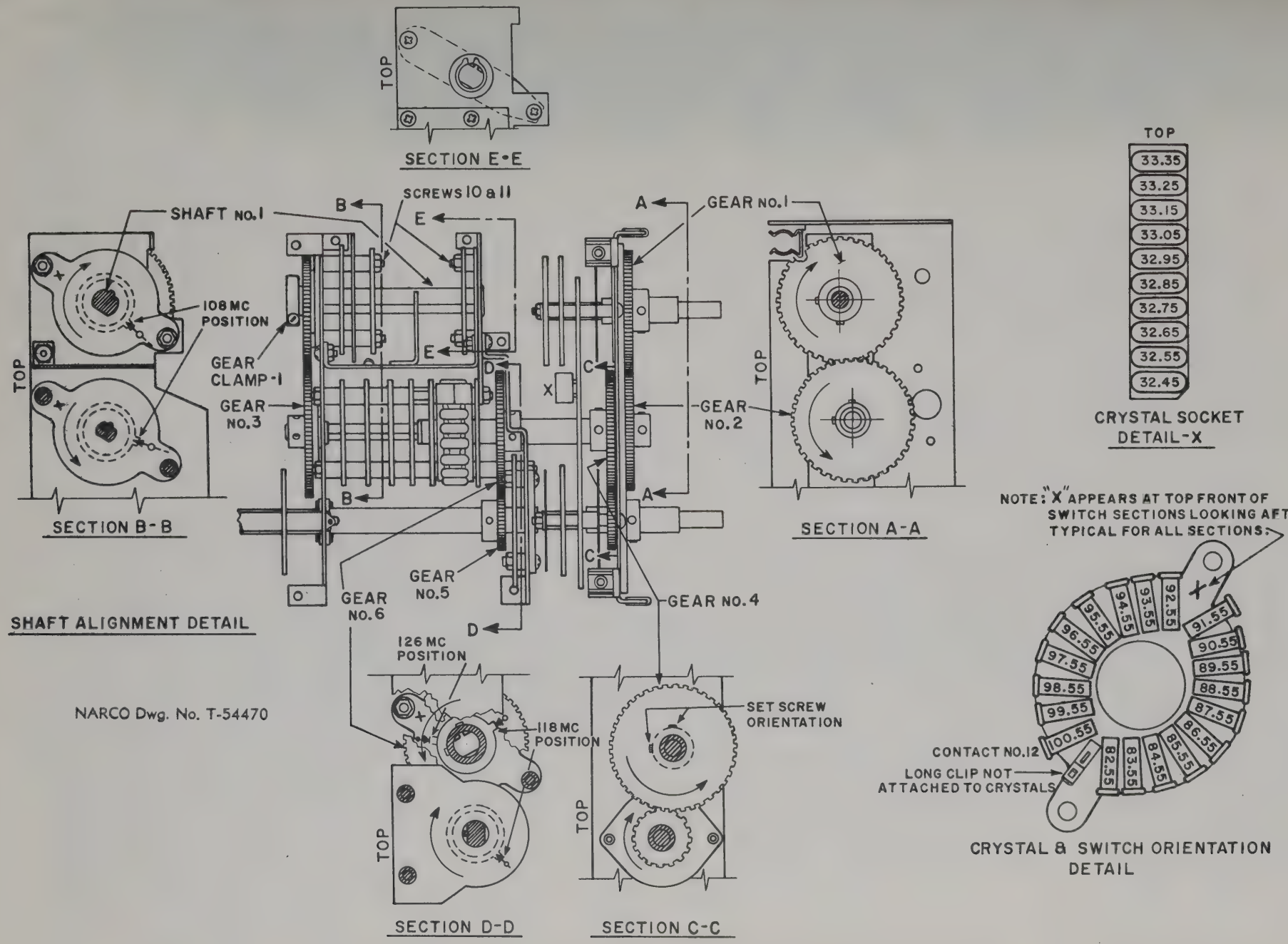

TOP
SECTION E-E
SHAFT NO.1
SCREWS 10 & 11
B
E
108 MC POSITION
GEAR CLAMP-1
GEAR NO.3
TOP
SECTION B-B
SHAFT ALIGNMENT DETAIL
NARCO Dwg. No. T-54470
A
GEAR NO.1
GEAR NO.2
TOP
SECTION A-A
TOP
33.35
33.25
33.15
33.05
32.95
32.85
32.75
32.65
32.55
32.45
CRYSTAL SOCKET DETAIL-X
NOTE: "X" APPEARS AT TOP FRONT OF SWITCH SECTIONS LOOKING AFT TYPICAL FOR ALL SECTIONS.
GEAR NO.6
GEAR NO.5
GEAR NO.4
126 MC POSITION
118 MC POSITION
SET SCREW ORIENTATION
SECTION D-D
SECTION C-C
CONTACT NO.12
LONG CLIP NOT ATTACHED TO CRYSTALS
CRYSTAL & SWITCH ORIENTATION DETAIL

Figure 10.

2. Connect VTVM, set on positive 50 volt range, to the isolation resistor.
3. Set receiver MC dial to 126 position. Tune L-114 for minimum positive voltage.
4. Set receiver MC dial to 108 position. Tune C-150 for minimum positive voltage.
5. Repeat steps 4 and 5 until no further decrease in voltage can be noted.

   Note: When not oscillating, 20 VDC can be observed at pin 2 of V-103; when oscillating, approximately 12 to 16 VDC can be observed at pin 2.

High Frequency IF Conversion Gain

1. Connect AC VTVM to the detector side of R-127.
2. Disconnect pin 1 of V-102 at L-125, leaving R-104 in the circuit.
3. Connect the HF signal generator, using 5uv. output in the 25 to 26 mc range, to pin 1 of V-102.
4. Set receiver KC dial to .00 position and tune the signal generator to 25.45 mc. Record indication of the AC VTVM.
5. Set receiver KC dial to .90 position and tune signal generator to 26.35 mc. Record indication of AC VTVM.
6. The .00 indication and the .90 indication should be approximately equal. (Between .6 and .8 VAC, with the .50 position no more than 6 db down).

Receiver RF Alignment

1. Connect AC VTVM on the detector side of R-127.
2. Set HF signal generator on 108 to 126 mc range, and connect the RF output to the receiver input. Use 10 uv. input.
3. Set receiver MC dial to the 126 position and KC dial to .50 position. Set signal generator to 126.50 mc.
4. Tune L-111, 112, and 113 for maximum AC VTVM indication.
5. Set receiver MC dial to 108 position and KC dial to.50 position. Set signal generator to 108.50 mc.
6. Tune C-102, 106, 108 for maximum AC VTVM indication.
7. Repeat steps 3, 4, 5, and 6 until no further increase in AC voltage can be obtained.
8. A level of 2 VAC should be obtained with an input of 5 to 10 uv. input across the band (108.0 to 126.9 mc.).

3. TRANSMITTER ALIGNMENT

Should it become necessary to re-align the VHF transmitter, the following alignment procedure must be observed, in the order indicated.

1. Connect an RF wattmeter and 50 ohm load to the transmitter antenna connector. Apply proper DC voltage to the equipment.
2. With the KC selector on .90 position, connect VTVM probe on the existing 1 megohm isolating resistor (this can be done by inserting the probe through the rubber grommet on the side of the chassis so that it makes contact with the binding post on which th resistor is mounted) on grid of LFO, pin 6 of V-106, with VTVM set on negative 15 volt range. Tune L-115 (LFO tank) for maximum reading. Check other positions, .9 to .0, to be sure all crystals are oscillating.
3. Using a 10K ohm resistor for isolation, connect the VTVM probe on the grid of the High Frequency Oscillator, Pin 7 of V-103, with the VTVM on the positive 50 volt range. Channel to 126 Mc and tune L-211 for minimum voltage. Channel to 118 Mc and tune C-205 for minimum. Repeat this operation several times, tuning L-211 at 126 Mc and C-205 at 118 Mc, until no further reduction in voltage is possible.
4. Set the VTVM to the negative 15 volt range, and connect the probe to the grid resistor (33K) of V-202, the First Buffer. Channel to 126.4 Mc and tune L-212 for maximum negative voltage. Channel to 118.4 Mc and tune C-213 for maximum voltage. Repeat this operation several times until no further increase in voltage is obtainable.
5. With the VTVM on the negative 50 volt range, connect the probe to the grid side of R-211 (12K), the Second Buffer (V-203) grid resistor. Channel to 126.4 Mc and tune L-213 for maximum negative voltage. Channel to 118.4 Mc and tune C-220 for maximum. Repeat these adjustments until no further increase in voltage is obtainable.
6. Connect the VTVM, set on the negative 150 volt range, on the grid side of R-214 (22K), the Final Amplifier grid resistor. Channel to 126.4 Mc. and tune L-214 for maximum voltage drive to the final; channel to 118.4 Mc and tune C-223 for maximum voltage. Repeat these adjustments for optimum tracking.
7. Channel to 118.4 Mc and tune C-230 for maximum power output, as indicated on the RF wattmeter. Channel to 126.4 Mc and tune L-215 for maximum power output. (Note: L-215 is tuned by changing the spacing between the turns of the 4-turn final tank coil). Repeat these two adjustments for maximum power output across the band.
8. **Final Check:**

   With the VTVM connected as in step 6, channel to 126.4 Mc and adjust L-212, L-213, and L-214 for maximum drive to the final. Channel to 118.5 Mc and adjust

C-213, C-220, and C-223 for maximum drive to the final amplifier. This drive should be at least 70 volts (negative) on all channels.

NOTE: The RF filter network on the output of the transmitter has been tuned at the factory. Adjustment of this filter is not part of transmitter alignment, and should not be attempted in the field.

D. POWER SUPPLY - MODULATOR UNIT

Since the T(-)MP-7 Power Supply—Modulator is a completely transistorized unit employing some of the most recent developments in power converters and audio circuitry, the following information is supplied to aid the service agency when testing or trouble-shooting the unit.

ADJUSTMENTS—

1. R-301—Normally set "full on" in the maximum clockwise position, unless high level aircraft cabin noise and a sensitive microphone causes the transmitted carrier to be modulated excessively. If this happens, the control should be turned counter-clockwise until the noise level does not interfere with normal speech.

WARNING

Transistors can be damaged or ruined if subjected to excessive voltage or current. Therefore, avoid the application of surges or high DC input to the T(-)MP-7, such as the no-load voltage from an unregulated DC bench power supply. Also avoid short-circuiting of primary, secondary or B-plus circuits to the chassis, or to adjacent terminals, while the unit is operating. Such excessive current or voltage may result in a condition known as "punch through," where the germanium barrier in the transistor shorts. Such failures may not occur at the moment of shorting, but at some later time. NOTE: Do not operate the T(-)MP-7 in an aircraft while the aircraft electrical system is connected to an auxiliary power unit.

TEST EQUIPMENT SET-UP

When servicing the T(-)MP-7, care must be taken to avoid damaging or shorting the transistors used in the power supply and modulator.

BENCH POWER SUPPLY

DC Power Units operating from the 115 volt AC line will require a suitable load resistor on the DC output terminals to improve the regulation and prevent voltage surges. The value and wattage rating of the resistor required for use with a particular supply will depend on the maximum current rating of the supply. A resistor of 3 ohms, 300 watts, connected across the DC source will draw 4.6 amperes at 13.75 volts, or 9.2 amperes at 27.5 volts; this should be sufficient constant load to provide good voltage regulation. We suggest connecting three 1-ohm, 100 watt resistors in series across the DC output terminals of the bench power source.

CHECKING POWER TRANSISTORS

Power transistors of the types used in the T(-)MP-7 may be checked for "shorted" condition with an ohmmeter. Using a Simpson Model 260 ohmmeter, on the "R x 1" scale, place the negative lead of the meter on the collector (stud) and the positive lead on the emitter (yellow lead). A "good" transistor will measure 200-500 ohms, or more, depending on its condition and the characteristics of the ohmmeter used.
Shorted transistors will measure 2 ohms, or less.

CHANGING TRANSISTORS

The transistors used in the power supply section (Q-401, 402) have their stud and case (collector) grounded to the heat sink on which they are mounted. Note, however, that the transistors in the audio circuit (Q-301, 302, 303) are insulated from the heat sink by thin pieces of mica sheet. It these transistors are to be changed, care must be taken to replace the mica insulation. Check with an ohmmeter between transistor case and ground to be sure the collectors are insulated from ground. When operating the unit, do not short the cases of these transistors to the chassis.

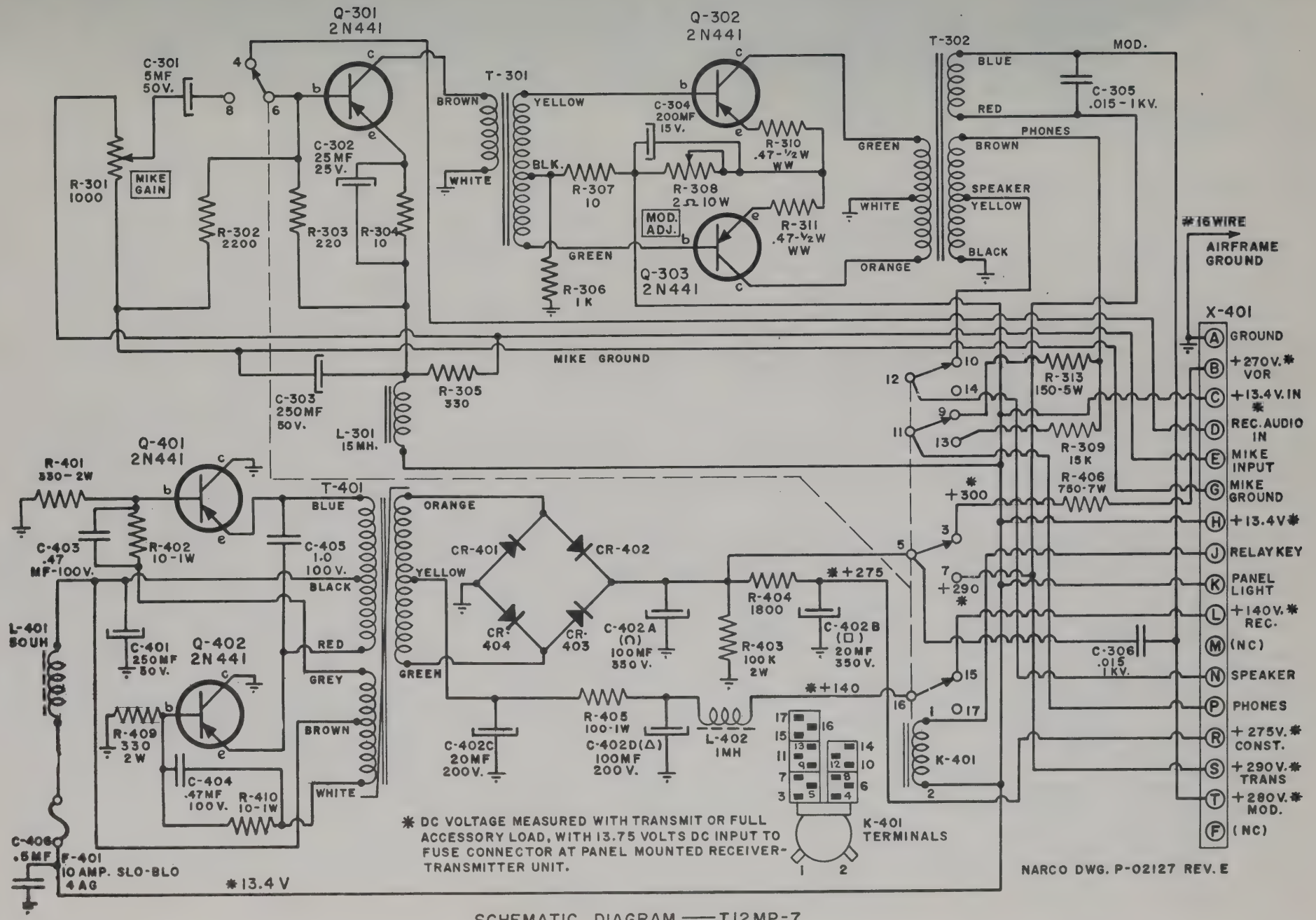
CHECKING AUDIO AMPLIFIER

The audio amplifier in the T(-)MP-7 may be checked for operation by applying an audio signal to pin "D" of X-401. An audio voltage of approximately 0.1 volts, RMS, applied at this point should produce 4-5 watts audio output from the 3 ohm speaker winding.

POWER SUPPLY VOLTAGE READINGS

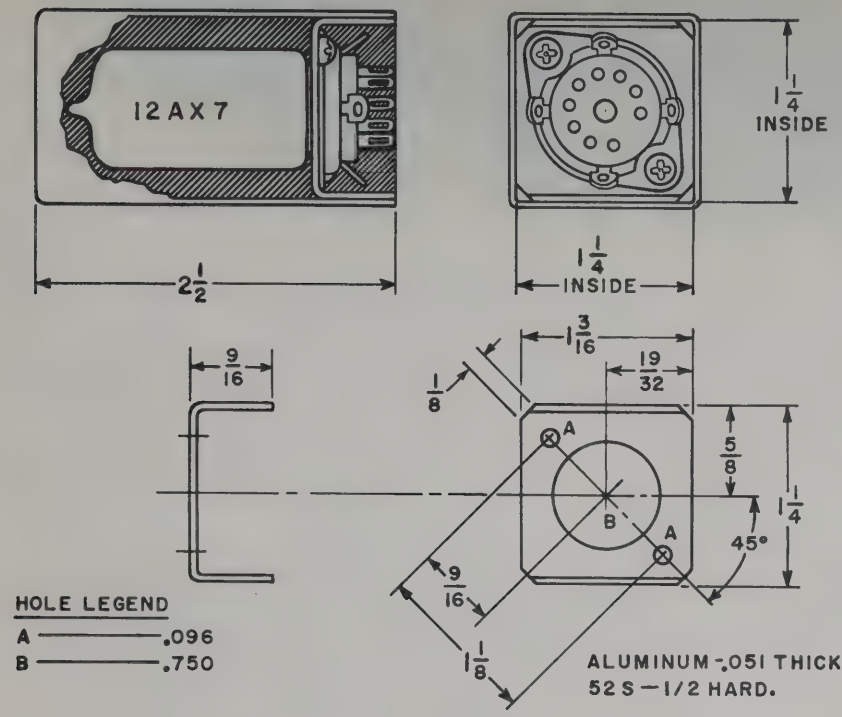
With the VHF transmitter-receiver unit connected to the T(-)MP-7, and with proper DC voltage applied, the following voltage readings should be measured at X-401:

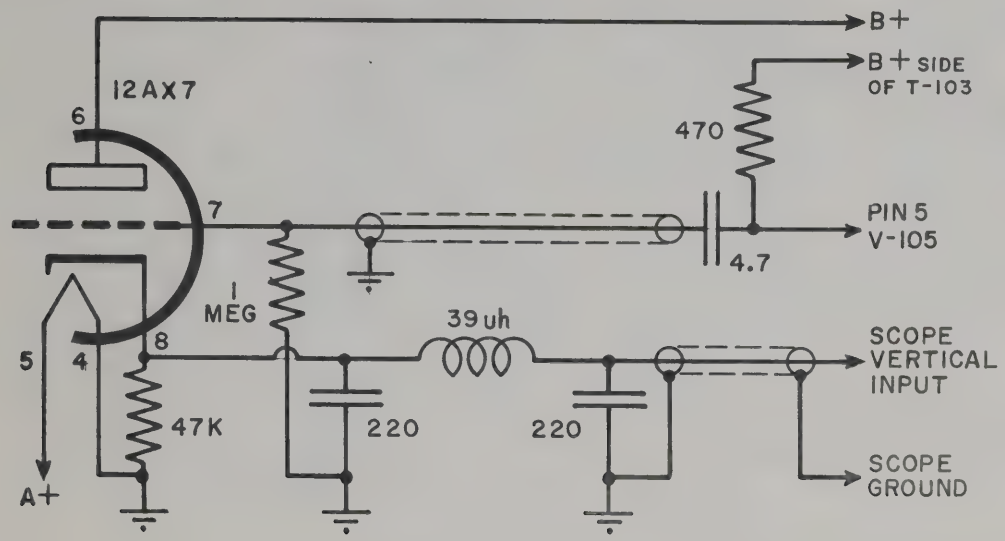
Pin	Function	
	Receive	Transmit
B	250. VDC ±10V	———
C	13.4 or 27.35 VDC	13.4 or 27.35 VDC
H	13.4 or 27.35 VDC	13.4 or 27.35 VDC
K	13.4 VDC	13.4 VDC
L	140 VDC ±10V	———
R	275 VDC ±10V	275 VDC ±10V
S	———	290 VDC ±10V
T	———	280 VDC ±10V



SCHEMATIC DIAGRAM —— T12MP-7
CHASSIS CNPA 50-B

Figure 11.


12AX7
2½
1¼ INSIDE
1¼ INSIDE
9/16
1 3/16
19/32
1/8
5/8
1¼
45°
9/16
1⅛
A
B
A
HOLE LEGEND
A .096
B .750
ALUMINUM -.051 THICK
52 S — 1/2 HARD.


B+
B+ SIDE OF T-103
12AX7
6
7
8
5
4
470
PIN 5 V-105
4.7
1 MEG
39 uh
SCOPE VERTICAL INPUT
47K
220
220
A+
SCOPE GROUND

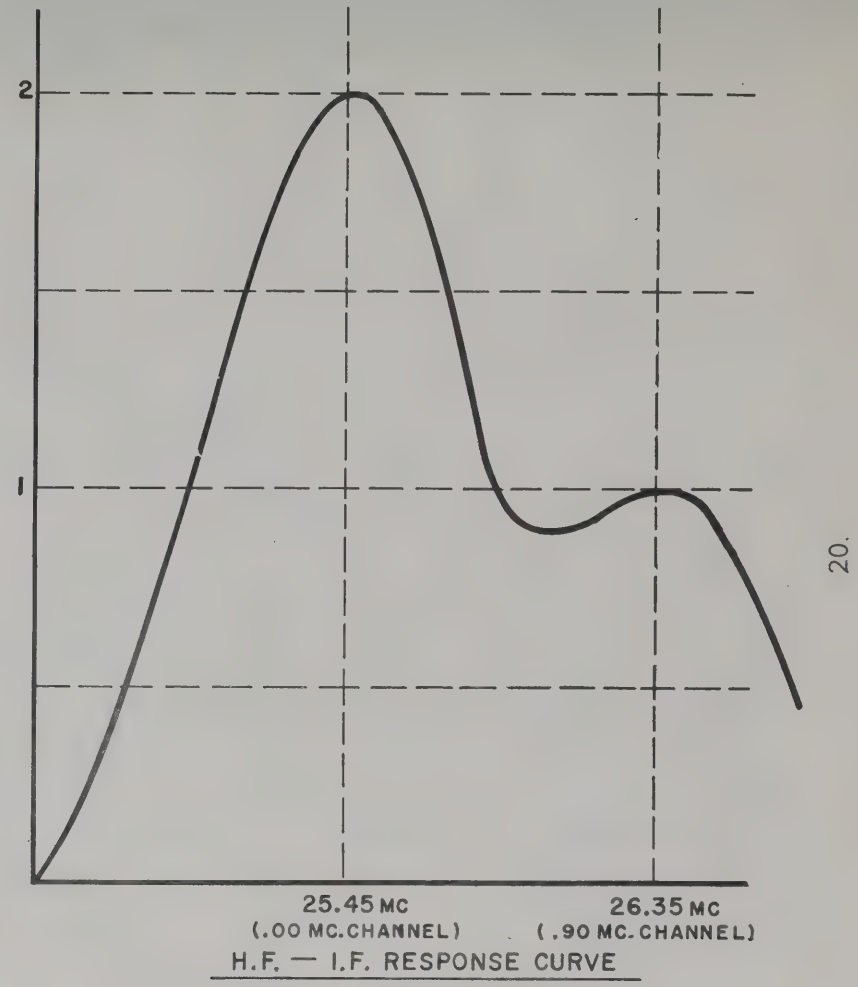
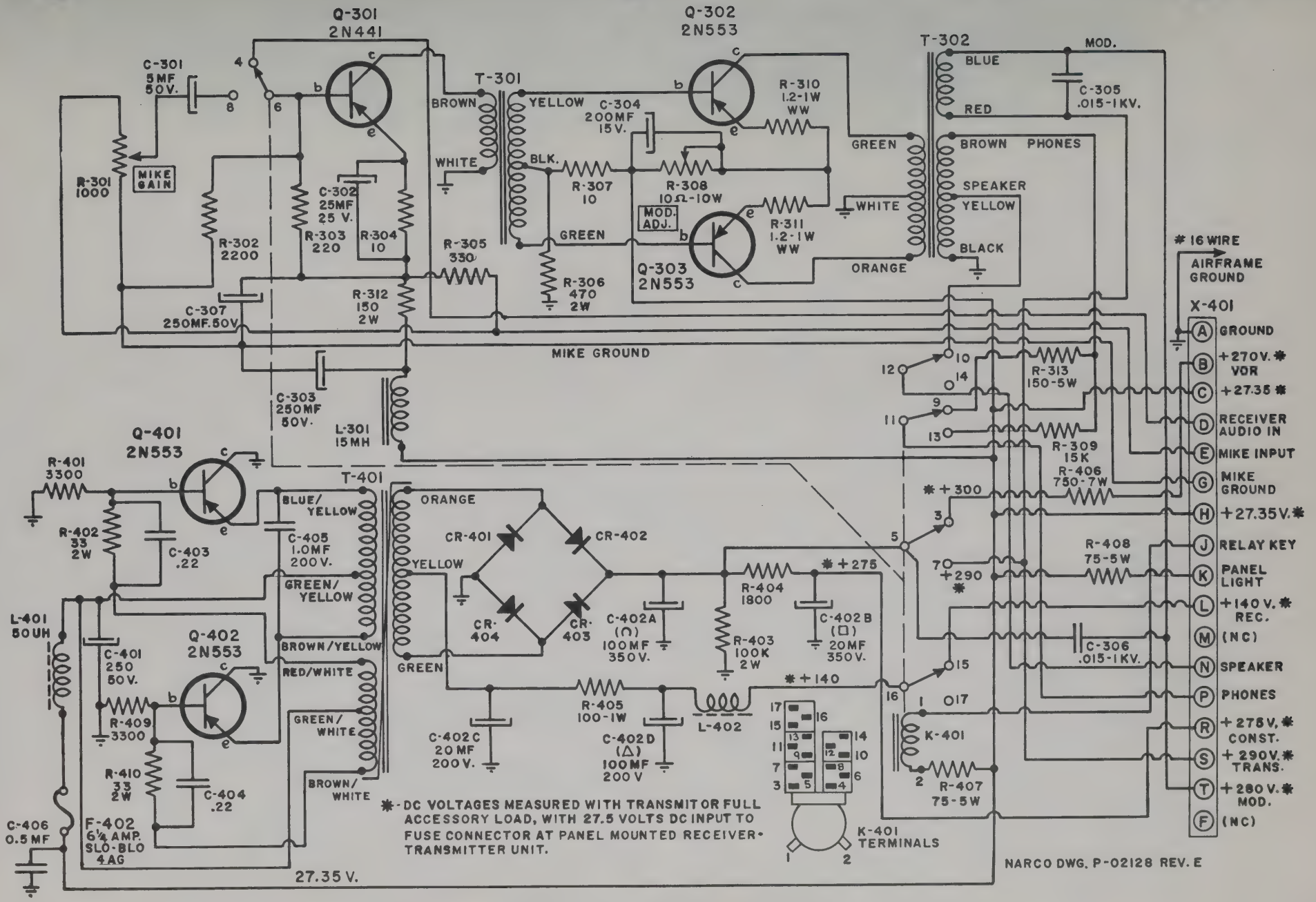

2
1
25.45 MC
(.00 MC. CHANNEL)
26.35 MC
(.90 MC. CHANNEL)
H.F. — I.F. RESPONSE CURVE

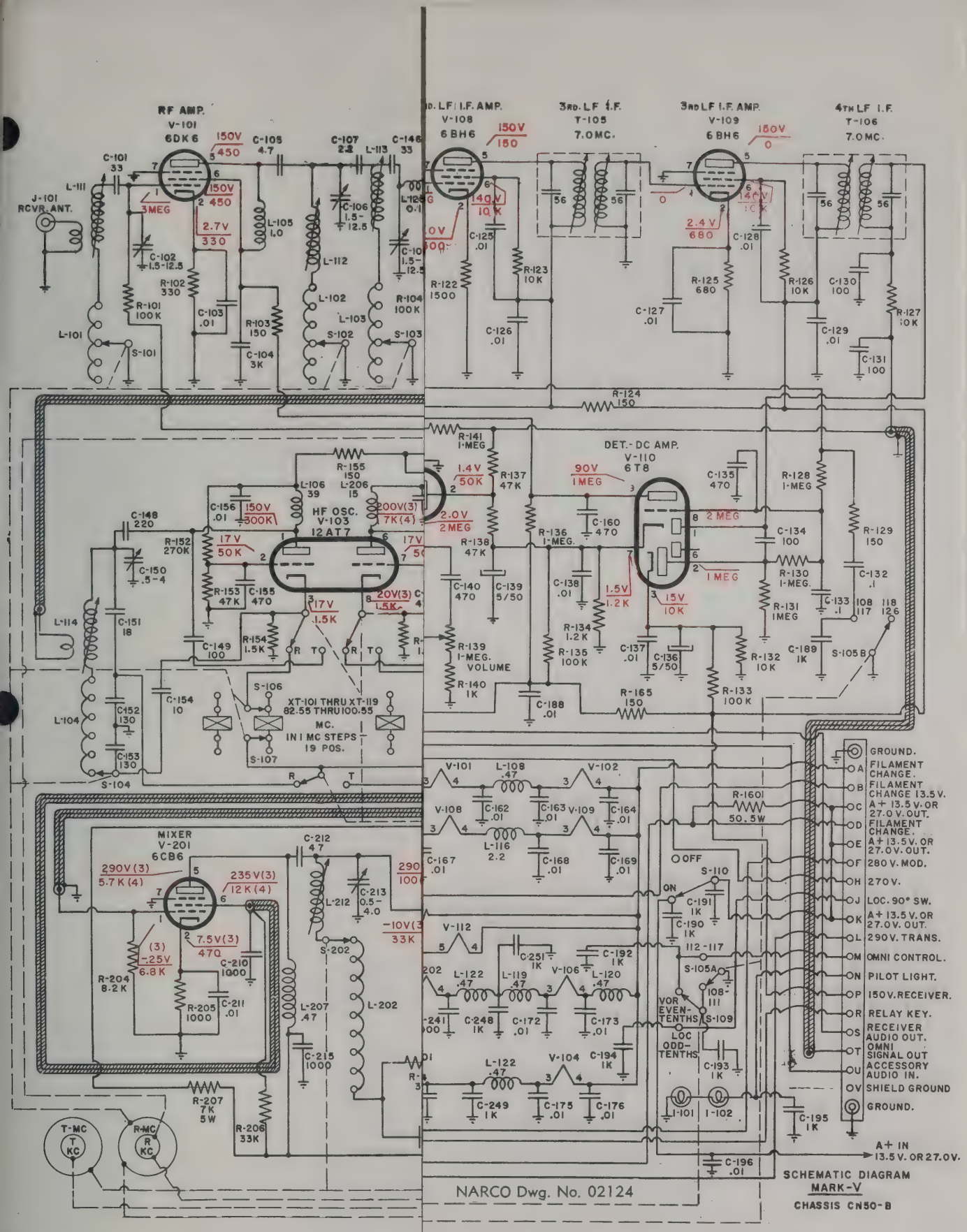
Figure 12.



SCHEMATIC DIAGRAM — T24MP-7

CHASSIS CNPB50-B

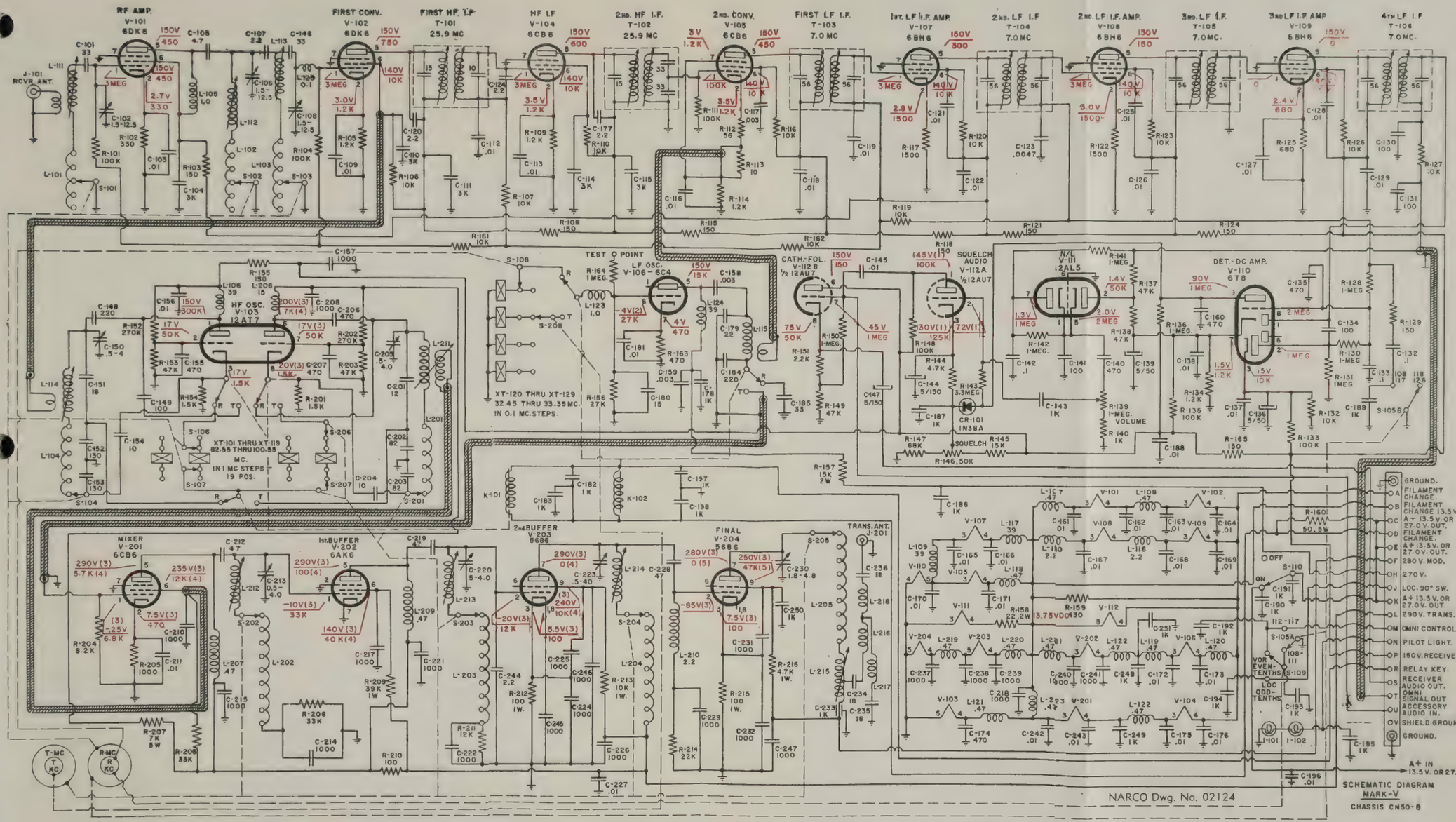
Figure 13.



NARCO Dwg. No. 02124

SCHEMATIC DIAGRAM
MARK-V
CHASSIS CN50-B

VOLTAGES ABOVE LINE AND RESISTANCES BE NED, VOLTAGE WILL INCREASE.
S FROM —3V. TO —8V., .00 TO .90 POSITION.
ALL DC VOLTAGES MEASURED TO GROUND, E , KEY DOWN, MEASURED THRU .47 uh. BLOCKING CHOKE.
VOLUME CONTROL AND SQUELCH CONTROL FU ".
ALL RESISTANCES MEASURED TO GROUND, WIT ".


RF AMP. V-101 6DK6
FIRST CONV. V-102 6DK6
FIRST HF. I.F. T-101 25.9 MC
HF I.F. V-104 6CB6
2ND. HF I.F. T-102 25.9 MC
2ND. CONV. V-105 6CB6
FIRST LF I.F. T-103 7.0 MC
1ST. LF I.F. AMP. V-107 6BH6
2ND. LF I.F. T-104 7.0 MC
2ND. LF I.F. AMP. V-108 6BH6
3RD. LF I.F. T-105 7.0 MC.
3RD LF I.F. AMP. V-109 6BH6
4TH LF I.F. T-106 7.0 MC.
J-101 RCVR. ANT.
HF OSC. V-103 12AT7
XT-101 THRU XT-119 82.55 THRU 100.55 MC. IN 1 MC STEPS 19 POS.
XT-120 THRU XT-129 32.45 THRU 33.35 MC. IN 0.1 MC. STEPS.
TEST POINT
LF OSC. V-106 - 6C4
CATH.-FOL. V-112 ½ 12AU7
SQUELCH AUDIO V-112 A ½ 12AU7
N/L V-111 12AL5
DET.-DC AMP. V-110 6T8
MIXER V-201 6CB6
1st BUFFER V-202 6AK6
2nd BUFFER V-203 5686
FINAL V-204 5686
TRANS. ANT. J-201
T-MC
R-MC
GROUND.
FILAMENT CHANGE.
FILAMENT CHANGE 13.5 V.
A+ 13.5 V. OR 27.0 V. OUT.
FILAMENT CHANGE
A+ 13.5 V. OR 27.0 V. OUT.
280 V. MOD.
270 V.
LOC. 90° SW.
A+ 13.5 V. OR 27.0 V. OUT.
290 V. TRANS.
OMNI CONTROL.
PILOT LIGHT.
150 V. RECEIVER.
RELAY KEY.
RECEIVER AUDIO OUT.
OMNI SIGNAL OUT
ACCESSORY AUDIO IN.
SHIELD GROUND
GROUND.
A+ IN 13.5 V. OR 27.0 V.
NARCO Dwg. No. 02124
SCHEMATIC DIAGRAM
MARK-V
CHASSIS CN50-8

VOLTAGES ABOVE LINE AND RESISTANCES BELOW LINE, SHOWN IN RED.
ALL DC VOLTAGES MEASURED TO GROUND, EXCEPT WHERE NOTED, WITH A HIGH IMPEDANCE VOLTMETER AT 13.75 VOLTS INPUT.
VOLUME CONTROL AND SQUELCH CONTROL FULLY COUNTER CLOCKWISE, EXCEPT WHERE NOTED.
ALL RESISTANCES MEASURED TO GROUND, WITH CABLES DISCONNECTED, EXCEPT WHERE NOTED.

NOTES: 1. AS SQUELCH IS OPENED, VOLTAGE WILL INCREASE.
2. GRID VOLTAGE VARIES FROM −3V. TO −8V., .00 TO .90 POSITION.
3. TRANSMIT POSITION, KEY DOWN, MEASURED THRU .47 uh. BLOCKING CHOKE.
4. MEASURED TO PIN "L".
5. MEASURED TO PIN "F".

SECTION V

REPLACEMENT PARTS

SYMBOL	PART No.	DESCRIPTION
C-107, 120, 124, 177, 244	21201-229	Capacitor, Ceramic, Tubular, 500V., NPO, 2.2 mmfd.
C-105	21201-479	" " " " " 4.7 "
C-154, 204	21201-100	" " " " " 10. "
C-201	21203-759	" " " " N150 7.5 "
C-180	21201-150	" " " " NPO 15. "
C-151	21203-180	" " " " N150 18. "
C-179	21201-220	" " " " NPO 22. "
C-104, 146, 185	21201-330	" " " " NPO 33. "
C-212, 219, 228	24507-35	" Fixed, Glass, 10%, 500V., 47. "
C-202, 203	21121-820	" Silver Mica, 5%, 500 V., 82. "
C-130, 131, 134, 141, 149	21308-101	" Ceramic, Tubular, " 100. "
C-152, 153	21121-131	" Silver Mica, 5%, " 130 "
C-148, 184	21308-221	" Ceramic, Tubular, " 220. "
C-135, 140, 155, 160, 174, 206, 207	21291-2	" " Disk, 470. "
C-143, 157, 178, 182, 183, 186, 187, 189-195, 197, 198, 208, 210, 214, 215, 217, 218, 221, 222, 224, 226, 229, 231, 232, 237, 238, 239, 240, 241, 245, 246, 248, 249, 250	24506-10	" " " 1000. "
C-247	21291-12	" A.B., 1000V., 1000. "
C-123	23065-109	" Fixed, Mylar, .0047 mfd.
C-104, 110, 111, 114, 115, 117, 158, 159	21291-4	" Ceramic, Disk .003 "
C-101, 103, 113, 121, 125, 127, 128, 161-173, 175, 176, 181, 211, 242, 243	21291-5	" " " .01 "
C-116, 118, 122, 126, 129, 137, 138, 145, 156, 188, 196, 227	21291-6	" " " .01 "
C-112, 119	23065-113	" Fixed, Mylar, .01 "
C-132, 133, 142	23064-25	" " " .1 "
C-136, 139	21524-49	" " Electrolytic, 50V., 5 "
C-144, 147	21524-35	" " " 150V., .5 "
C-234, 236	24504-25	" Porcelain, 18 mmfd.
C-230	22027-1	" Air Variable, 1.8-4.0 "
C-233	24505-1	" Ceramic, Feed-thru, 1000 "
C-102, 106, 108	22019-2	" Variable Plunger type 1.5-12.5 "
C-150, 205, 213, 220, 223	22023-3	" Trimmer, Glass 0.5-4.0 "
C-235 (L-127)	24524-25	" Porcelain, (with integral coil), 18 "
CR-101	75008-1	Crystal Diode, 1N388
I-101, 102		Lamp, panel, GE No. 51, red
J-101		Connector, Antenna, Receiver
J-201		" " Transmitter
K-101	65126-10	Relay, 3PDT
K-102	65129-1	Relay, miniature, DPDT
L-125	11138-20	Choke, R.F., 0.1 microhenry
L-107, 108, 118 to 122, 208, 219 to 223, 207	11138-5	Choke, 0.47 microhenry
L-105, 123	11138-7	Choke, 1.0 microhenry
L-110, 116, 210	11138-9	Choke, 2.2 microhenry
L-206	11138-19	Choke, 15 microhenry
L-106, 109, 117, 124	11359-20	Choke, 39 microhenry
L-111	11412-11	Coil, RF grid
L-112	11412-12	Coil, RF plate
L-113	11412-13	Coil, converter grid
L-114	11412-14	Coil, HF oscillator, receiver
L-115	11273-4	Coil, LF oscillator
L-211	11412-16	Coil, HF oscillator, transmitter
L-212	11273-1	Coil, locked oscillator grid
L-213	11273-2	Coil, buffer grid

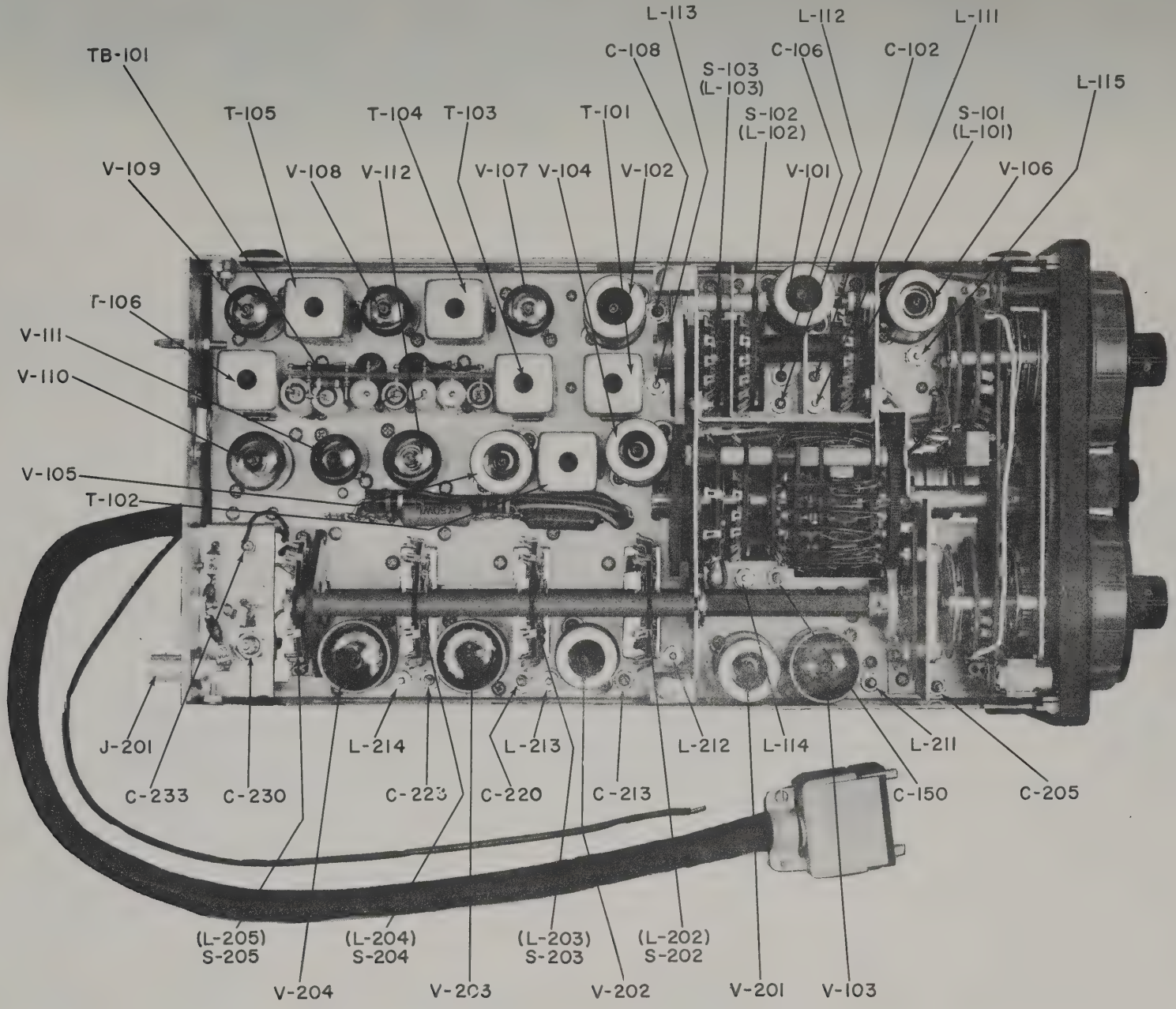

TB-101
T-105
T-104
T-103
T-101
L-113
L-112
L-111
C-108
C-106
C-102
S-103
(L-103)
S-102
(L-102)
S-101
(L-101)
L-115
V-109
V-108
V-112
V-107
V-104
V-102
V-101
V-106
T-106
V-111
V-110
V-105
T-102
J-201
L-214
L-213
L-212
L-114
L-211
C-233
C-230
C-223
C-220
C-213
C-150
C-205
(L-205)
S-205
(L-204)
S-204
(L-203)
S-203
(L-202)
S-202
V-204
V-203
V-202
V-201
V-103

Figure 15.

SYMBOL	PART No.	DESCRIPTION
L-214	11273-3	Coil, buffer plate
L-215	11274-1	Coil, air final
L-216, 218	11416-1	Coil, RF filter
L-217		Coil, RF filter: part of C-235
R-113	31141-100	Resistor, Carbon, ±10%, 1/2 watt, 10 ohms
R-112	31141-560	" " " " 56 "
R-103, 108, 118		
R-103, 108, 118, 121, 124, 129, 155, 115	31110-151	150 "
R-102	31110-331	" " " " 330 "
R-163	31110-471	" " " " 470 "
R-125	31110-681	" " " " 680 "
R-140, 205	31110-102	" " " " 1000 "
R-105, 109, 114	31141-122	" " " " 1200 "
R-154, 201, 117, 122	31141-152	" " " " 1500 "
R-151	31110-222	" " " " 2200 "
R-204	31110-822	" " " " 8200 "
R-107, 110, 116, 119, 120, 123, 126, 161, 162, 106,	31110-103	" " " " 10K "
R-211	31110-123	" " " " 12K "
R-145	31110-153	" " " " 15K "
R-214	31110-223	" " " " 22K "
R-156	31110-273	" " " " 27K "
R-137, 138, 149, 153, 203 148	31110-473	" " " " 47K "
R-208, 206	31110-333	" " " " 33K "
R-147	31110-683	Resistor, Carbon, ±10%, 1/2 watt, 68K ohms
R-101, 104, 111, 133, 135	31110-104	" " " " 100K "
R-152, 202	31110-274	" " " " 270K "
R-130, 131, 136, 141, 142, 150, 164	31110-105	" " " " 1 Megohm
R-143	31110-335	" " " " 3.3 "
R-212, 215, 210	31135-101	" " " " 100 ohms
R-159	31135-431	" " " " 430 "
R-216	31135-472	" " " " 4700 "
R-213	31135-103	" " " " 10K "
R-209	31135-393	" " " " 39K "
R-158	31113-220	" " " 2 " " 22K "
R-157	31136-153	" " " " " 15K "
R-160	31118-500	" Wire " 5 " 50 "
R-207	31162-5	" " ±5% 5 " 7000 "
R-139, 146	32028-1	Potentiometer, dual, with switch, 1 megohm and 50K ohms
S-101, 102, 103	61284-1	Switch, 20-position, step inductor (L-101, 102, 103)
S-104,	61285-1	Switch, 20-position, step inductor (L-104)
S-105	61283-1	" AVC, VOR/ILS
S-106, 107	61282-1	" 20-position, crystal selector
S-108, 208	61278-1	Switch, 20 position, crystal selector
S-109	61279-1	" " odd-even select
S-110		" power, part of R-139
S-201	61286-1	" step inductor (L-201)
S-202, 205	61294-102	" step inductor assembly (L-202, 205)
S-203, 204	61294-101	" " " " (L-203, 204)
S-206	61280-1	" crystal selector
S-207	61281-1	" " "
T-101	11269-1	Transformer. IF, 27.5 MC
T-102	11270-1	" " "
T-103, 104, 105	11207-1	" IF interstage, 7Mc.
T-106	11268-1	" IF output, 7 MC.

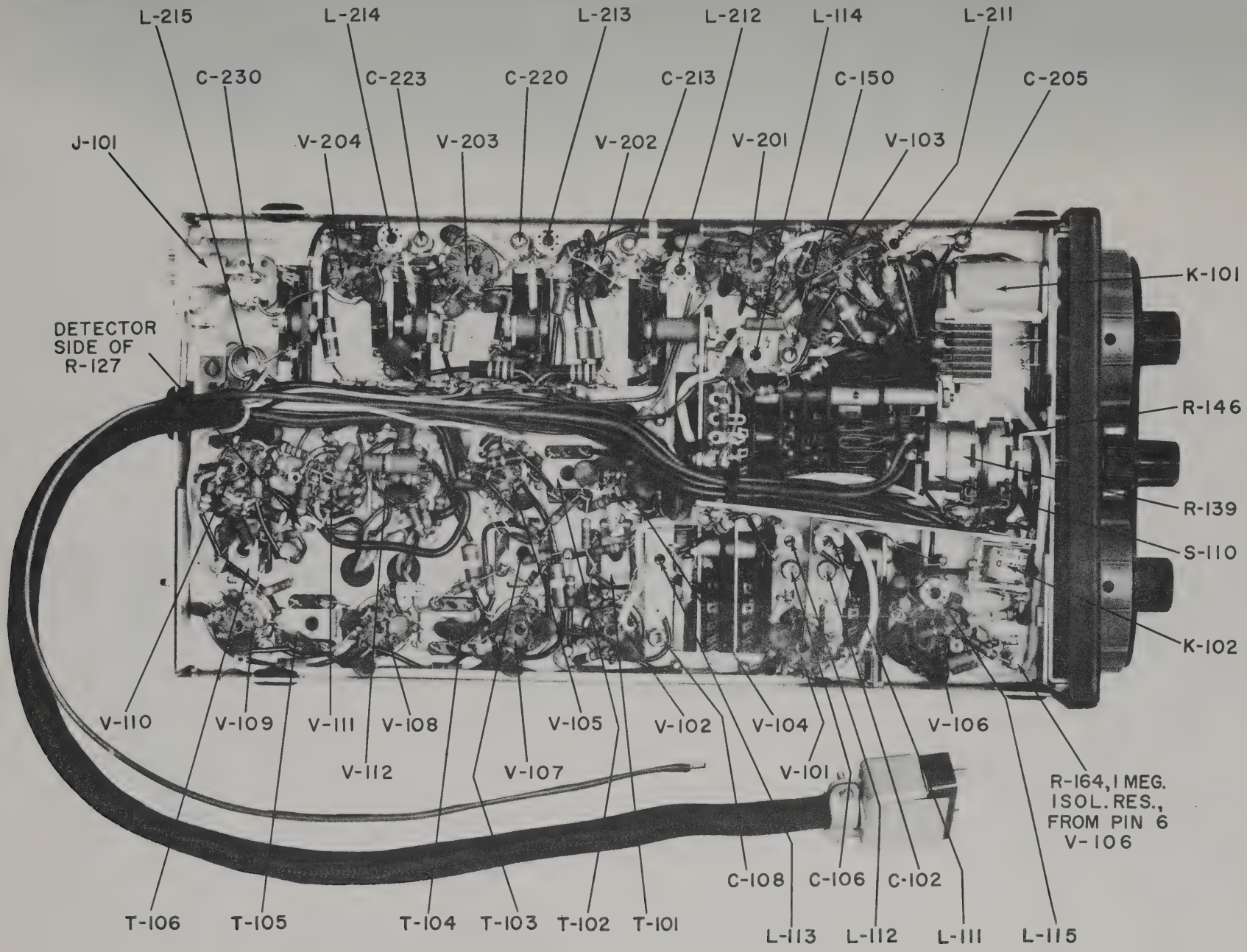
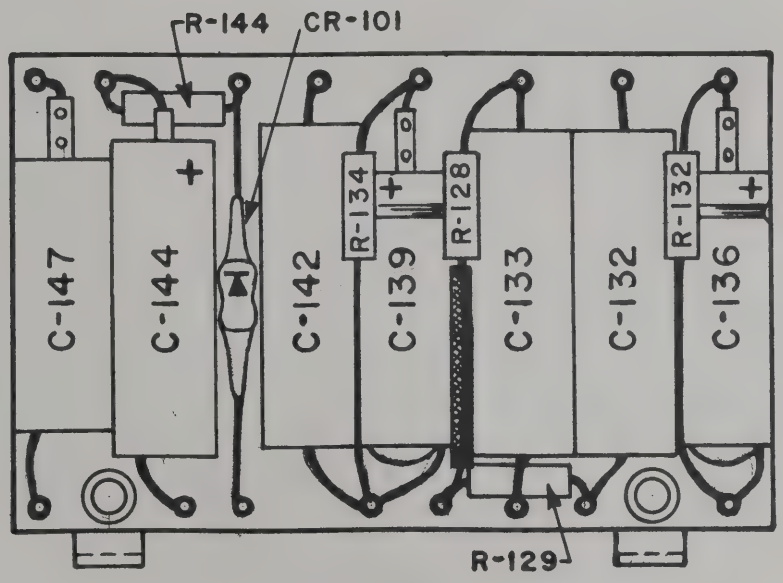

L-215
L-214
L-213
L-212
L-114
L-211
C-230
C-223
C-220
C-213
C-150
C-205
J-101
V-204
V-203
V-202
V-201
V-103
K-101
DETECTOR SIDE OF R-127
R-146
R-139
S-110
K-102
V-110
V-109
V-111
V-108
V-105
V-102
V-104
V-106
V-112
V-107
V-101
R-164, 1 MEG. ISOL. RES., FROM PIN 6 V-106
C-108
C-106
C-102
T-106
T-105
T-104
T-103
T-102
T-101
L-113
L-112
L-111
L-115

Figure 16.

SYMBOL	PART No.	DESCRIPTION	
XT-101 thru XT-119	72012-103	Crystal, Quartz, Wire-in, MC	Kit, 82.55-100.55 Mc.
XT-101	72007-75	" " " "	82.55 Mc. 108 Mc.
XT-102	72007-76	" " " "	83.55 Mc. 109 Mc.
XT-103	72007-77	" " " "	84.55 Mc. 110 Mc.
XT-104	72007-78	" " " "	85.55 Mc. 111 Mc.
XT-105	72007-79	" " " "	86.55 Mc. 112 Mc.
XT-106	72007-80	" " " "	87.55 Mc. 113 Mc.
XT-107	72007-81	" " " "	88.55 Mc. 114 Mc.
XT-108	72007-82	" " " "	89.55 Mc. 115 Mc.
XT-109	72007-83	" " " "	90.55 Mc. 116 Mc.
XT-110	72007-84	" " " "	91.55 Mc. 117 Mc.
XT-111	72007-85	" " " "	92.55 Mc. 118 Mc.
XT-112	72007-86	Crystal, Quartz, Wire-in,	93.55 Mc. 119 Mc.
XT-113	72007-87	" " " "	94.55 Mc. 120 Mc.
XT-114	72007-88	" " " "	95.55 Mc. 121 Mc.
XT-115	72007-89	" " " "	96.55 Mc. 122 Mc.
XT-116	72007-90	" " " "	97.55 Mc. 123 Mc.
XT-117	72007-91	" " " "	98.55 Mc. 124 Mc.
XT-118	72007-92	" " " "	99.55 Mc. 125 Mc.
XT-119	72007-93	" " " "	100.55 Mc. 126 Mc.
XT-120 thru XT-129	72012-104	Crystal, Quartz, Plug-in, KC	Kit, 32.45-33.35 Mc.
XT-120	72006-170	Crystal, Quartz, Plug-in,	32.45 Mc. .00 Mc.
XT-121	72006-171	" " " "	32.55 Mc. .10 Mc.
XT-122	72006-172	" " " "	32.65 Mc. .20 Mc.
XT-123	72006-173	" " " "	32.75 Mc. .30 Mc.
XT-124	72006-174	" " " "	32.85 Mc. .40 Mc.
XT-125	72006-175	" " " "	32.95 Mc. .50 Mc.
XT-126	72006-176	" " " "	33.05 Mc. .60 Mc.
XT-127	72006-177	" " " "	33.15 Mc. .70 Mc.
XT-128	72006-178	" " " "	33.25 Mc. .80 Mc.
XT-129	72006-179	" " " "	33.35 Mc. .90 Mc.



TB—1

Figure 17.

SYMBOL	PART No.	DESCRIPTION
C-301	21524-20	Capacitor, electrolytic, 50 V., 5 Mfd.
C-302	21524-10	" " 25 V., 25 "
C-303, 307	21524-50	" " 50 V.,250 "
C-304	21524-44	" " 15 V.,200 "
C-305, 306	21189-153	" paper, 1000 V.,.015 "
C-401	21524-48	" electrolytic 50 V.,250 "
C-402	21525-14	" " 200 V., 20-100 "
C-403, 404		350 V., 20-100 "
(T12MP-7)	23065-83	" Mylar, ±10%, 100 V., .47 "
C-403, 404		
(T24MP-7)	23064-79	" " 100 V., .22 "
C-405		
(T12MP-7)	23065-187	" " ±10%, 100 V., 1 "
	23065-187	" " " 200 V., 1 "
C-406	21402-504	" metallized, 200 V., .5 "
CR-401, 402, 403, 404	75202-1	Rectifier, silicon
F-401		
(T12MP-7)	66504-12	Fuse, slow blow, 10 ampere, 4 AG
F-401		
(T24MP-7)	66504-10	" " " 6.25 " "
K-401	65126-5	Relay, 5 PDT
L-301	11215-3	Choke, filter, 15 millihenry
L-401	11176-3	" hash, 50 microhenry
L-402	11360-10	" encapsulated, 1 millihenry, 80 Ma.
Q-301	75504-1	Transistor, 2N441, DELCO
Q-302, 303		
(T-12MP-7)	75504-2	" matched pair, 2N441, DELCO
Q-302, 303		
(T-24MP-7)	75503-2	" " " 2N553, DELCO
Q-401, 402		
(T-12MP-7)	75504-1	" 2N441, DELCO
Q-401, 402		
(T-24MP-7)	75503-1	" 2N553, DELCO
R-301	32001-5	Resistor, variable, linear, 1000 ohms
R-302	31110-222	" carbon, 10%, 1/2 watt 2200 "
R-303	31110-221	" " " " " 220 "
R-304, 307	31141-100	" " " " " 10 "
R-305,	31110-331	" " " " " 330 "
R-306		
(T-12MP-7)	31110-102	" " " " " 1000 "
R-306		
(T-24MP-7)	31110-151	" " " " " 150 "
R-308		
(T12MP-7)	33002-209	" adjustable, wire, 10 watt, 2 "
R-308		
(T24MP-7)	33002-100	" " " " " 10 "
R-309	31110-153	" carbon, 10%, 1/2 watt 15K "

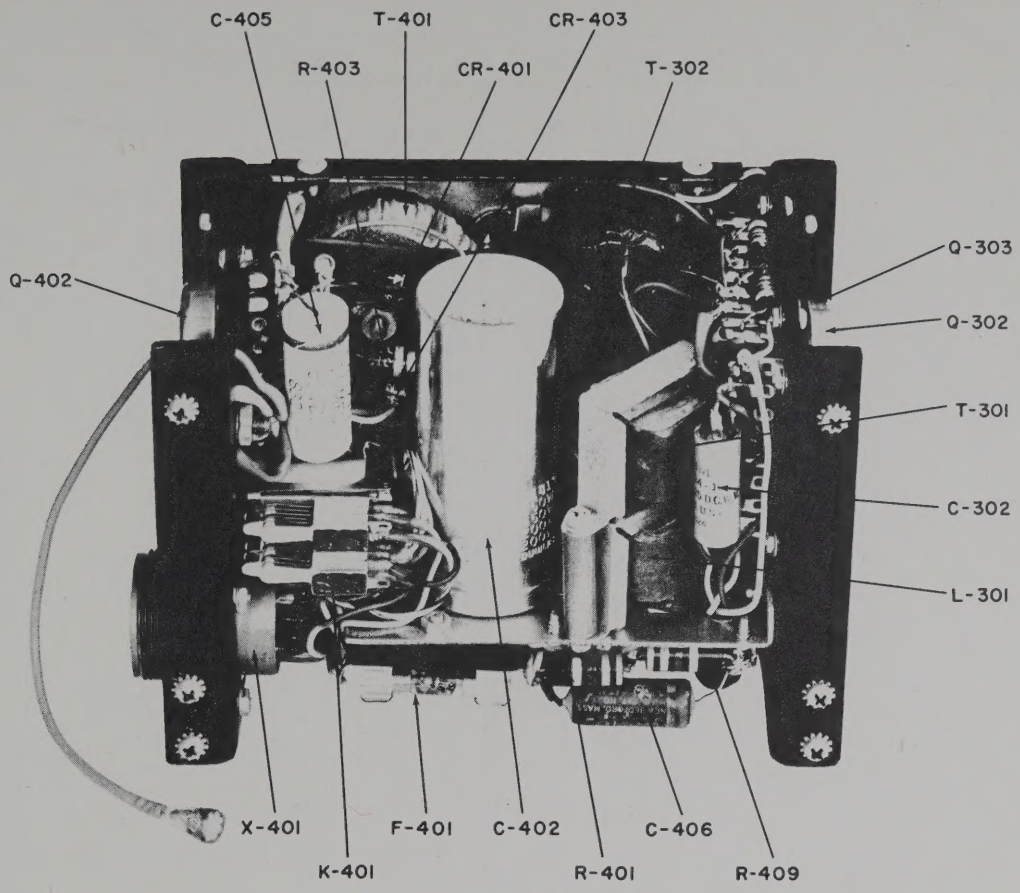


Figure 18.

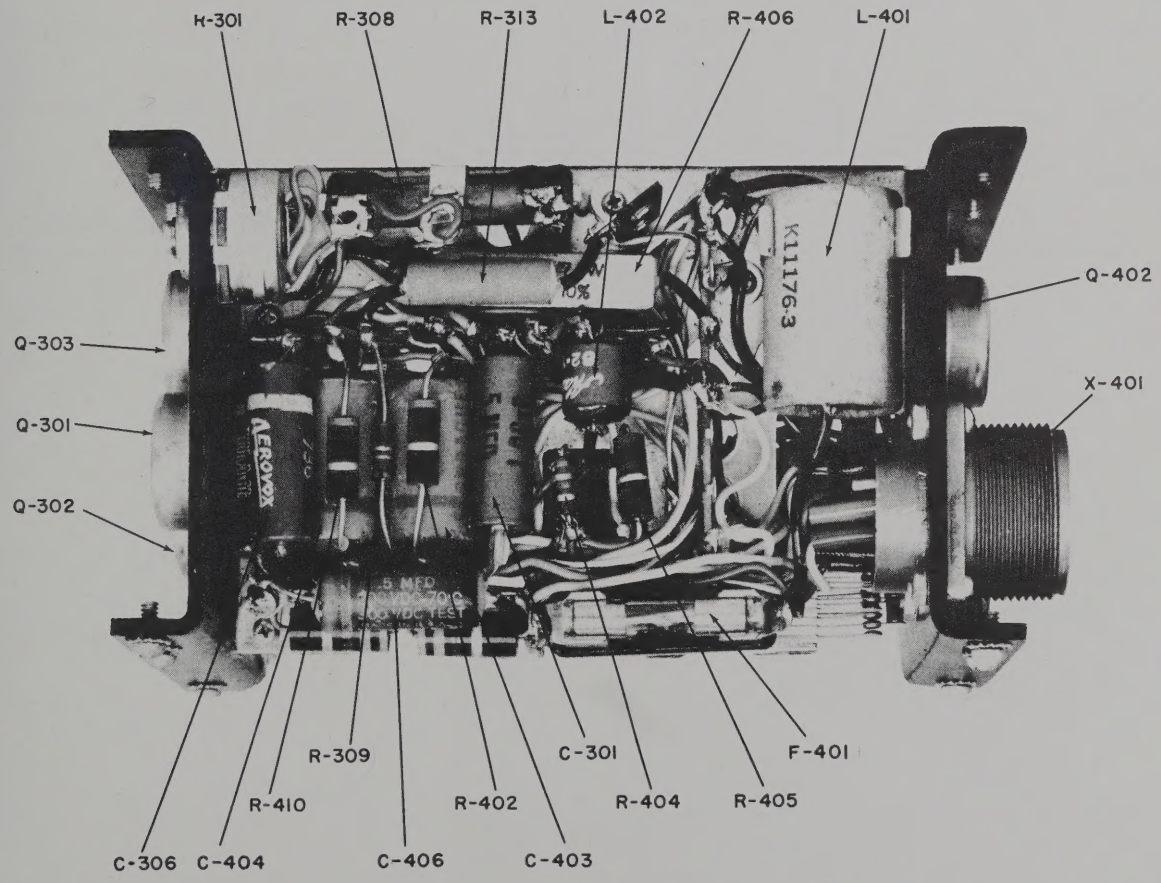


Figure 19.

SYMBOL	PART No.	DESCRIPTION
R-310,311 (T12MP-7)	31139-478	Resistor, wire, 10% 1/2 watt .47 ohms
R-310,311 (T24MP-7)	31125-129	" " " 1 watt, 1.2 "
R-312	31136-151	" carbon, " 2 " 150 "
R-313	31118-151	" wire, " 5 " 150 "
R-401,409 (T12MP-7)	31136-331	" carbon, " 2 " 330 "
R-401,409 (T24MP-7)	31110-332	" " " 1/2 " 3300 "
R-402,410 (T12MP-7)	31135-100	" " " 1 " 10 "
R-402,410 (T24MP-7)	31136-330	" " " 2 " 33 "
R-403	31136-104	" " " " " 100K "
R-404	31135-182	" " " 1 " 1800 "
R-405	31135-101	" " " 1 " 100 "
R-406	31175-3	" wire " 7 " 750 "
R-407,408 (T24MP-7)	31162-1	" " " 5 " 75 "
T-301	11272-101	Transformer, transistor driver
T-302 (T-12MP-7)	11271-101	" transistor output
T-302 (T-24MP-7)	11271-102	" " "
T-401 (T12MP-7)	11275-1	" power, toroid, DC converter
T-401 (T24MP-7)	11276-1	" " " " "
X-401	41233-103	Receptacle, 17-pin, AN-3102A-20-29P